Aviation Week

Including **Space Technology**

October 19, 1959

Special Report On IATA General Meeting

Atlas 18-D Launched with Operational Nose Cone

The Only Jet Transport to Meet or Exceed Every Performance Estimate

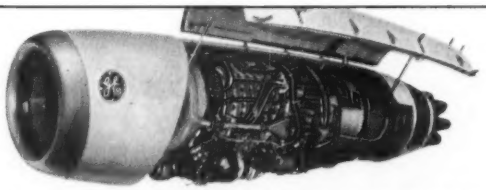
Convair's Jet 880 Powered by General Electric

YEARS AHEAD FOR YEARS TO COME!

In producing the Jet 880, Convair engineers have applied all of the knowledge gained during more than 35 years of building military and commercial aircraft.

The Convair 880 was thoroughly and painstakingly tested in wind tunnels and in static rigs which simulate every aerodynamic stress of flight. Airline pilots and engineers joined with Convair experts in perfecting the clear-vision cockpit. Human Engineering at Convair and contract designers made certain the passenger cabin would be the most luxurious ever planned.

Now after months of intensive flight testing, Convair's 880 has met or exceeded every performance guarantee. Powered by General Electric CJ-805 turbojets, the Jet 880 has proved it can cruise at 615 miles an hour in level flight—the world's *fastest* and most versatile jet transport. Outstanding fuel economy and storage capacity make it ideal for medium and transcontinental routes. With improvements in design and engineering that are as much as five years ahead of other jet transports now in production, the Jet 880, built by Convair, a Division of General Dynamics, has dramatically advanced the scope of the Jet Age—to bring you jet travel that is *years ahead for years to come!*



GENERAL ELECTRIC'S CJ-805—Power Plant for the world's fastest and most versatile airliner...

Convair's Jet 880 is powered by four General Electric CJ-805 turbojets. Advanced design and light weight of the CJ-805 engines make possible the outstanding thrust and rapid throttle response—from ground idle to full takeoff thrust in only 5.6 seconds. Since 1941, General Electric has been America's leader in the production of jet engines. The CJ-805, a result of this unmatched experience, brings maximum speed and dependability to the Convair Jet 880.

CONVAIR
A DIVISION OF **GENERAL DYNAMICS CORPORATION**

First to offer Convair 880 or 600 Jet-Liner service will be TWA, DELTA, TRANSCONTINENTAL (Argentina), REAL-AEROVIAS (Brazil), S.A.S., SWISSAIR, AMERICAN, C.A.T. (Formosa)

BEING INTEGRATED INTO TOMORROW'S AIRCRAFT AND MISSILE SYSTEMS

NEW VICKERS Variable Displacement Hydraulic Pumps with MAXIMUM HP/LB RATIO

Model Series	Displacement cu. in./rev.	RPM		Weight lb.	HP/LB*	
		Limited Life	Rated		Limited Life	Rated
PV006	.095	18,200	12,500	2.8	4.55	3.12
PV012	.188	14,500	10,000	4.5	4.45	3.06
PV024	.367	11,600	8,000	6.9	4.53	3.13
PV039	.600	10,000	8,000	10.2	4.33	3.46
PV062	.950	8,900	7,000	14.0	4.44	3.49
PV104	1.600	7,500	5,800	19.0	4.65	3.59
PV163	2.500	6,500	5,100	26.0	4.60	3.60

***This is hydraulic output horsepower at 3000 psi**

The above table is important to anyone concerned with the selection of hydraulic pumps for future air or space vehicles. Note particularly the horsepower-to-weight ratios for both rated and limited life speeds. These are the highest known available at this time.

But highest hp/lb is only one of many advantages offered you by the new Vickers advanced design variable displacement pumps. Developed to meet the requirements of the new MIL-P-19692 specification, this new series has volumetric efficiencies of 96% to 98% over a pressure range of 500 to 3000 psi . . . and has 4000 psi continuous operation capabilities. These pumps have faster response and improved contamination resistance; they have practically the same envelope as constant displacement units of equal output. The first five sizes are now being integrated into advanced aircraft and missile systems; the two larger sizes are in the development stage. Write for Bulletin A-5233 for additional information.

Variable Hydraulic Motors using the Advanced Design Series concept are now under development.

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Aero Hydraulics Division — Engineering, Sales and Service Offices:

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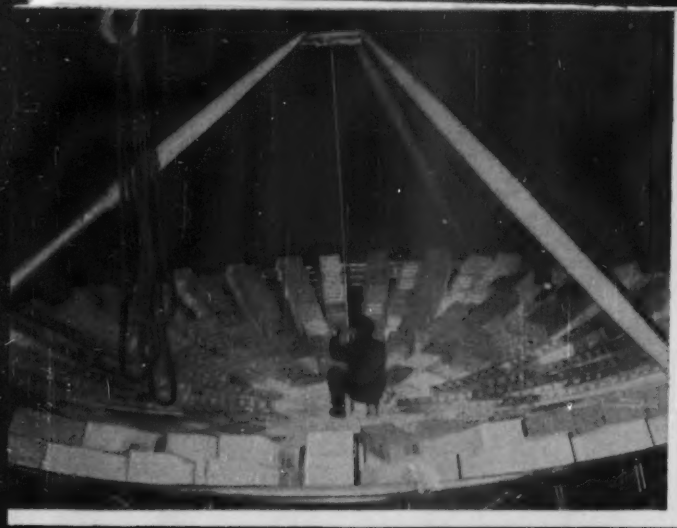
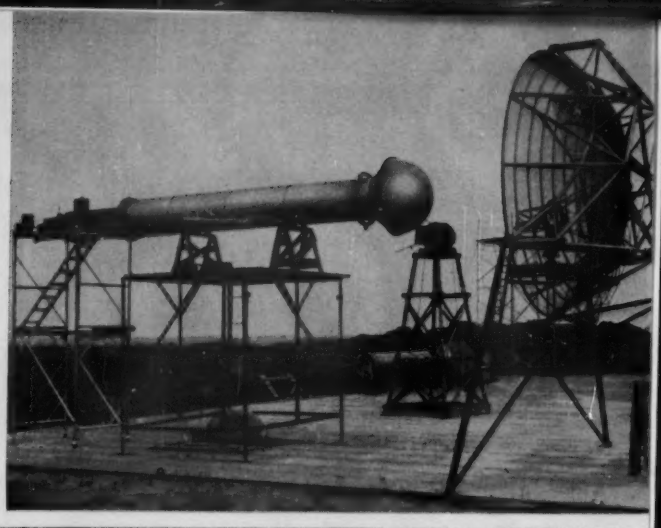
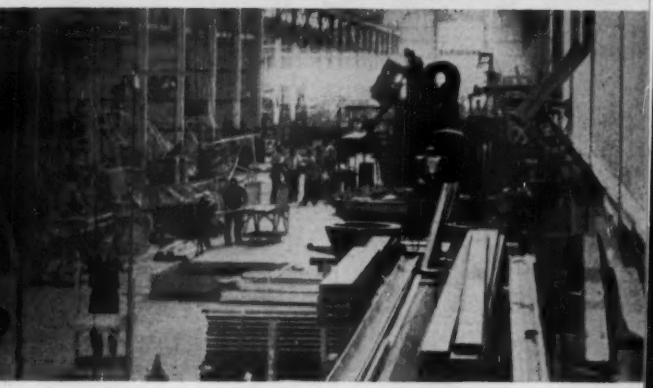
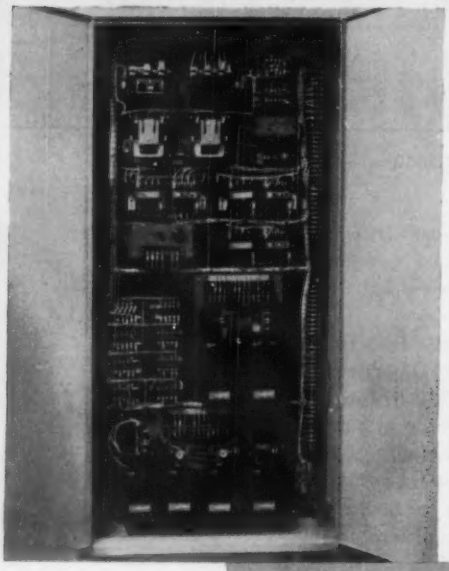


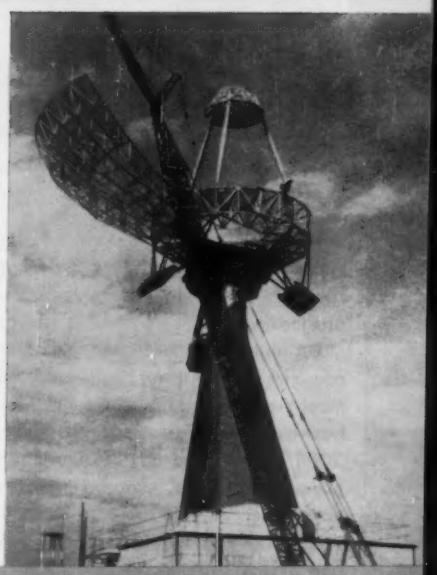


In antenna systems

KENNEDY capability is total capability







TOTAL *capability in the field of antenna systems?*

It's the capability to do the basic R & D in microwave propagation . . . to design and develop the antenna system . . . . to manufacture the dish, the mount, and all waveguide components, horns, etc. . . . to provide complete field engineering service which includes site surveying, construction and erection, final checkout, and servicing.

In short, it's the capability *to do it all* — a *total* service from a single source.

ANTENNA EQUIPMENT

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Down-to-earth SOLUTIONS *to out-of-this-world* PROBLEMS

Tracking Antennas-Radio Telescopes-Radar Antennas
"Trans-Horizon" Antennas-Tropospheric Scatter
Ionospheric Scatter

AVIATION CALENDAR

Oct. 26-28—First International Symposium on Gas Lubricated Bearings, Washington, D. C. For information: S. W. Doroff, Power Branch, Office of Naval Research, Washington 25, D. C.; Prof. D. D. Fuller, Franklin Institute, Laboratories for R&D, Philadelphia 3, Pa.

Oct. 26-28—Sixth Annual East Coast Conference, Institute of Radio Engineers' Professional Group for Aeronautical and Navigational Electronics, Lord Baltimore Hotel, Baltimore, Md. (Some classified sessions, sponsored by Air Research and Development Command.)

Oct. 26-30—National Conference, Society of Photographic Scientists & Engineers, Edgewater Beach Hotel, Chicago, Ill.

Oct. 28-29—Sixth Annual Computer Applications Symposium, Morrison Hotel, Chicago, Ill. Sponsor: Armour Research Foundation of Illinois Institute of Technology.

Oct. 28-30—Annual Industry Display, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 29-30—Fifth Annual Electron Devices Meeting, Institute of Radio Engineers' Professional Group on Electron Devices, Shoreham Hotel, Washington, D. C.

Nov. 2-4—National Midwestern Meeting on New Frontiers in Aviation, Institute of the Aeronautical Sciences, Hotel Lassen, Wichita, Kan.

Nov. 2-5—Fall Meeting, Western States Section, Combustion Institute, Institute of the Aeronautical Sciences Bldg., Los Angeles, Calif. Subject: Equilibria and Performance of High Temperature Systems.

Nov. 3-5—11th Annual Mid-America Electronics Conference, Hotel Muehlebach, Kansas City, Mo. Sponsor: Institute of Radio Engineers' Kansas City Section.

Nov. 4-6—National Automatic Control Conference, Sheraton Hotel, Dallas, Tex.

(Continued on page 6)

AVIATION WEEK Including Space Technology

October 19, 1959

Vol. 71, No. 16

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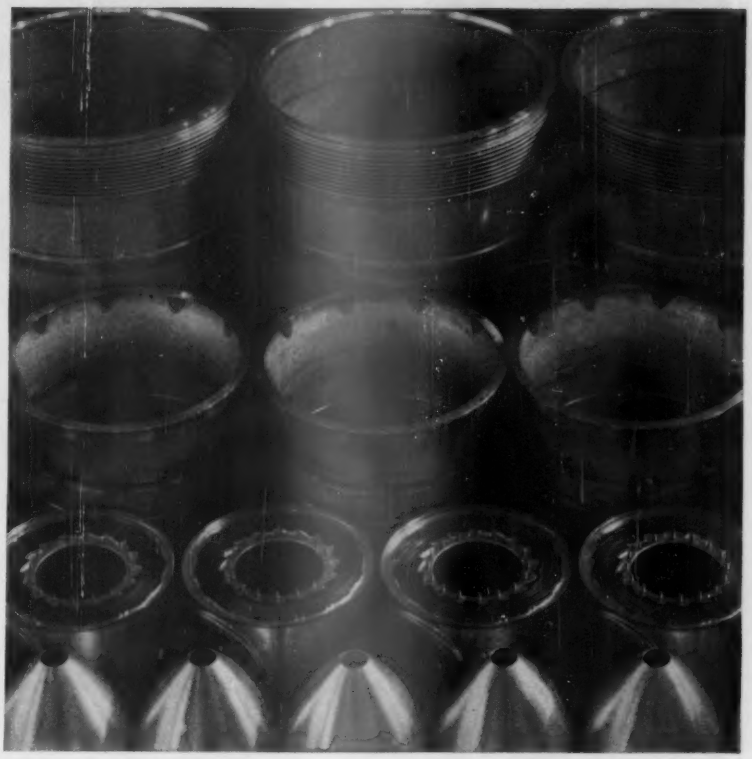

high temperature / AVIATION COMPONENTS BY LAVELLE

Lavelle manufactures aviation components to meet the most critical demands of high temperature operation. Typical of the many high temperature units produced in quantity by experienced Lavelle craftsmen are the jet engine tail pipes, engine casings and heat exchangers shown above.

Lavelle specializes in the production of precision sheet metal weldments and assemblies made of titanium, aluminum, stainless steel, and heat-resistant nickel alloys . . . joined by welding methods applicable to specific component design and function. Where required, special tools are designed and fabricated by Lavelle to maintain production quality, reduce costs . . . and promote on-schedule delivery.

If your requirements for component performance demand the very highest standards of component workmanship, call on Lavelle . . . or write for brochure describing specialized skills and facilities ready to serve your needs.

Lavelle

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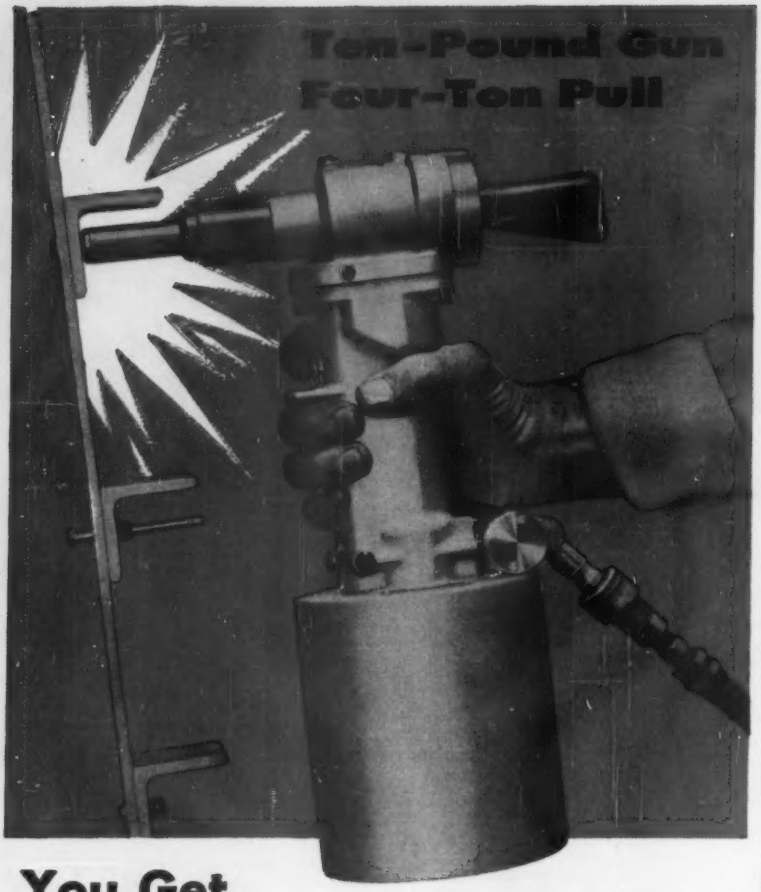
Between Philadelphia, Pa., and Trenton, N.J.



You Get MORE POWER—Less Weight with the *New* CHERRY G-85 Lockbolt Gun

The new Cherry G-85 lockbolt gun is designed to give you maximum pulling power with less weight. Its simplified rugged construction assures low maintenance costs. The gun weighs only 10.5 pounds, which reduces operator fatigue.

No special air supply is required with this lightweight gun, because it develops this high capacity at normal line pressure.

As the leader in the field of special aircraft fasteners, Cherry Research and Development department has produced this new lightweight, high capacity gun to increase the efficiency of installing lockbolts.* The G-85 gun may be adapted for setting stainless steel, monel, aluminum and carbon steel Cherry blind rivets.

For information on the new Cherry G-85 gun write Townsend Company, Cherry Rivet Division, Post Office Box 2157-N, Santa Ana, California.

*Licensed under Huck patents RE22,792; 2,114,493; 2,527,307; 2,531,048; 2,531,049 and 2,754,703

CHERRY RIVET DIVISION

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Townsend Company

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AVIATION CALENDAR

(*Continued from page 5*)

Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Instrument Society of America; American Society of Mechanical Engineers. AIEE is conducting a parallel Control System Components Conference on Nov. 5-6.

Nov. 9-11—Fourth Instrumentation Conference and Exhibit, Biltmore Hotel, Atlanta, Ga. Sponsors: Institute of Radio Engineers' Professional Group on Instrumentation and the Atlanta Section.

Nov. 9-20—13th Annual Air Transportation Institute, American University's School of Business Administration, Washington, D. C.

Nov. 11-13—16th National Meeting, Operations Research Society of America, Huntington-Sheraton Hotel, Pasadena, Calif.

Nov. 12-13—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Marrott Hotel, Indianapolis, Ind.

Nov. 16-19—14th Annual Meeting and Astronautical Exposition, American Rocket Society, Sheraton-Park Hotel, Washington, D. C.

Nov. 16-20—20th Annual Convention, National Aviation Trades Assn., Hotel Montleone, New Orleans, La.

Nov. 17—Fall Meeting, Society of Aircraft Materials and Process Engineers' Eastern Division, Sheraton Carlton Hotel, Washington, D. C.

Nov. 17-18—Technical Seminar, American Society of Tool Engineers, Sheraton Hotel, Philadelphia, Pa. Topic: Problems of Machining Space Age Metals.

Nov. 17-18—National Turbine-Powered Air Transportation Meeting, Institute of the Aeronautical Sciences, Fairmont Hotel, San Francisco, Calif.

Nov. 17-19—34th Meeting, Aviation Distributors and Manufacturers Assn., Diplomat Hotel and Country Club, Hollywood, Fla.

Nov. 17-19—1959 Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Boston Commonwealth Armory, Boston, Mass.

Nov. 19-20—Seventh Annual Aircraft and Missile Division Conference, American Society for Quality Control, Sheraton-Dallas Hotel, Dallas, Tex.

Nov. 23-24—Symposium on Solid Facts about Solid State, Instrument Society of American, Ben Franklin Hotel, Philadelphia, Pa.

Nov. 30-Dec. 4—Fourth Annual Naval Air Weapons Meet, Operation "Top Gun," Marine Corps Auxiliary Air Station, Yuma, Ariz.

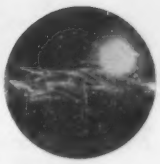
Nov. 30-Dec. 4—First industry and government-wide training course in Value Engineering & Analysis, Industrial Education Institute, Boston, Mass.

Dec. 1-3—Eastern Joint Computer Conference, Statler Hilton Hotel, Boston, Mass. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Assn. for Computing Machinery.

Dec. 7-8—Classified symposium on "The Plasma Sheath, Its Effect on Communication and Detection," Boston, Mass. Sponsor: Electronics Research Directorate, Air Force Cambridge Research Center.

Explorer VI is a space laboratory orbiting around the earth with paddles capturing sunlight for power

The scientific data that will some day enable us to probe successfully to the very fringes of the universe is being recorded and transmitted at this moment by the space laboratory Explorer VI, a satellite now in orbit around the earth ● This project, carried out by Space Technology Laboratories for the National Aeronautics and Space Administration under the direction of the Air Force Ballistic Missile Division, will advance man's knowledge of: *The earth and the solar system . . . The magnetic field strengths in space . . . The cosmic ray intensities away from earth . . . and, The micrometeorite density encountered in inter-planetary travel* ● Explorer VI is the most sensitive and unique achievement ever launched into space. The 29″ payload, STL designed and instrumented by STL in cooperation with the universities, will remain "vocal" for its anticipated one year life.



How? Because Explorer VI's 132 pounds of electronic components are powered by storage batteries kept charged by the impingement of solar radiation on 8,000 cells in the four sails or paddles equivalent to 12.2 square feet in area ● Many more of the scientific and technological miracles of Explorer VI will be reported to the world as it continues its epic flight. The STL technical staff brings to this space research the same talents which have provided systems engineering and over-all direction since 1954 to the Air Force Missile Programs including Atlas, Thor, Titan, Minuteman, and the Pioneer I space probe.

Important staff positions in connection with these activities are now available for scientists and engineers with outstanding capabilities in propulsion, electronics, thermodynamics, aerodynamics, structures, astrophysics, computer technology, and other related fields and disciplines.

Space Technology Laboratories, Inc.

Inquiries and resumes are invited.

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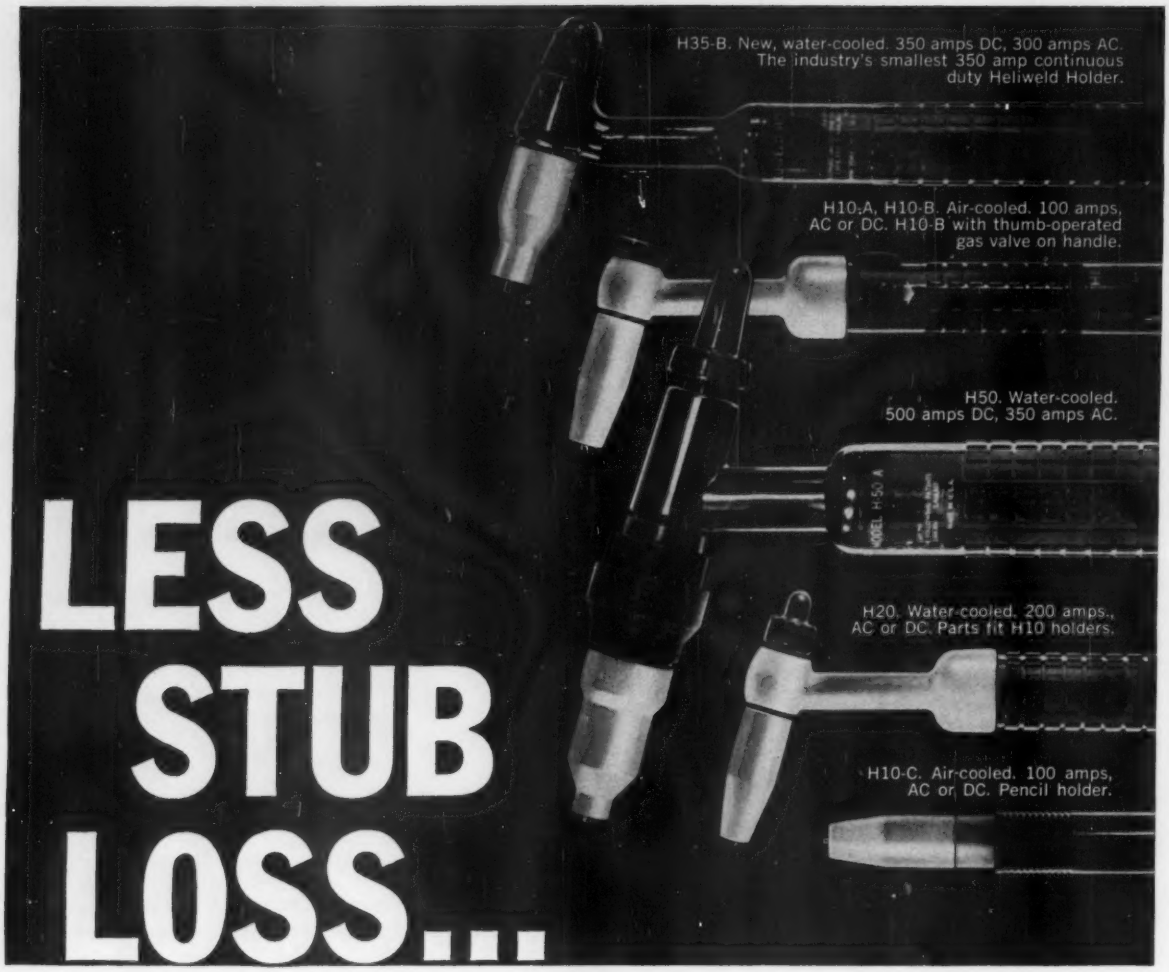
Los Angeles 45, California


H35-B. New, water-cooled. 350 amps DC, 300 amps AC. The industry's smallest 350 amp continuous duty Heliweld Holder.
H10-A, H10-B. Air-cooled. 100 amps, AC or DC. H10-B with thumb-operated gas valve on handle.
H50. Water-cooled. 500 amps DC, 350 amps AC.
H20. Water-cooled. 200 amps., AC or DC. Parts fit H10 holders.
H10-C. Air-cooled. 100 amps, AC or DC. Pencil holder.
LESS STUB LOSS...

one of 4 big reasons why you'll go for these AIRCO Heliweld Holders

1. LESS ELECTRODE LOSS—You can reduce stub losses as much as 50% when Heliwelding thin gauge aluminum, stainless, copper base alloys, zirconium, magnesium or killed steel . . . if you use an Airco manual Heliweld Holder. You throw away less than one inch of stub (not 3 inches).

You make other savings too. You use alumina nozzles, for example, which have high resistance to heat and impact shock. You save on the gas, because you need less for adequate coverage.

2. A HOLDER FOR EVERY JOB—The complete range of Airco Heliweld Holders, rated from 100 to 500 amps, assures proper holder selection for your job.

3. FULL CAPACITY RATINGS—The five Airco Heliweld Holders provide for the industry's widest range of current selection in a single integrated line. Holders are rated at full capacity for continuous duty cycle for argon or helium, AC or DC. Non-turbulent gas flow and high current density combine to give you welds of X-ray quality.

4. EASIER HANDLING—For easier handling try the new H35-B. You'll find it the standout holder for work in tight corners. All of the holders feature Airco's non-slip corncob handle. Weights are a mere 4 ozs. to 11 ozs.

Heliweld Economy Packs are available from your Authorized Airco Dealer. He's listed in the Yellow Pages under "Welding Equipment and Supplies".

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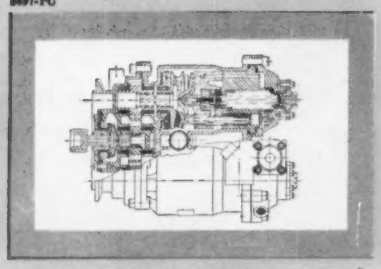
PESCO SPECIALISTS DESIGN IN HI-TEMPERATURE HYDRAULIC PUMP FOR FAIL-SAFE OPERATION!

The environmental factors of supersonic performance necessitate new concepts of dependability in air weapon subsystems and components. To meet the requirement for fail-safe operation, PESCO engineers have created a new *dual-element high-temperature pump for main hydraulic systems.* This advanced design features two independent pumping elements housed in a single body and driven by a common shaft. Failure of either element does not affect over-all performance because *each is capable of meeting the system's flow requirements.*

This dual element design exemplifies Pesco's creative engineering capabilities for specialized high-temperature hydraulic pumps and motors. Precision units featuring fluid temperatures to 550°F and over-all efficiencies of 90% can be supplied to meet your specific requirements. *For details, call your nearest Pesco representative or write direct.*

8691-PC



Operating on 25-100 psig inlet press. and 550°F inlet temp., this PESCO Dual Element Design discharges 21.5 gpm at 4000 psi.

PESCO PRODUCTS DIVISION
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Creative Engineering for the Space Age

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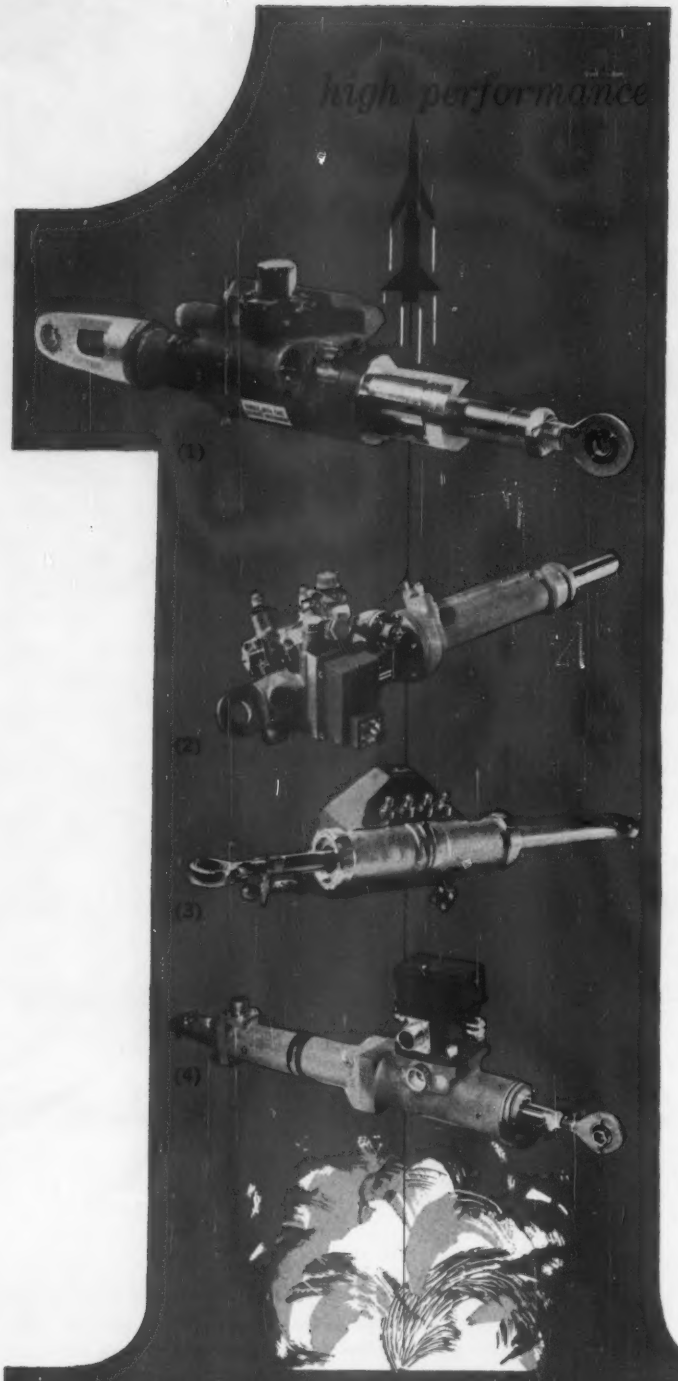

CONTROL— IN ONE INTEGRATED PACKAGE

HYDRAULIC RESEARCH designs and builds complete packages for engine, flight and other precision control. Servo, actuator, filters, transducers, valves, potentiometers – all are integrated into one single unit that simplifies test and check. Hydraulic Research control packages are in use, now, on leading aircraft, missile and space

Typical:

(1) **On ICBM.** Controls rocket engine position. **First fully qualified control actuator.** Features extreme environment servo valve.

(2) **On IRBM.** For engine positioning. Features mechanical position feedback.

(3) **On newest interceptor.** Actuates control surfaces. Features dual hydraulic systems. Responds to manual or electrical commands.

(4) **On satellite** (final stage). Engine position control. Features cylinder snubbers, and load limiters.

Hydraulic Research, **originator of the dry coil servo valve,** is thoroughly experienced in the servo and control field. Use this design background and proven production proficiency to your advantage. Write for further information.

HR

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PRECISION ELECTRO-HYDRAULIC SERVO CONTROLS

HYDRAULIC & PNEUMATIC VALVES

PRESSURE SWITCHES

GPL data handling

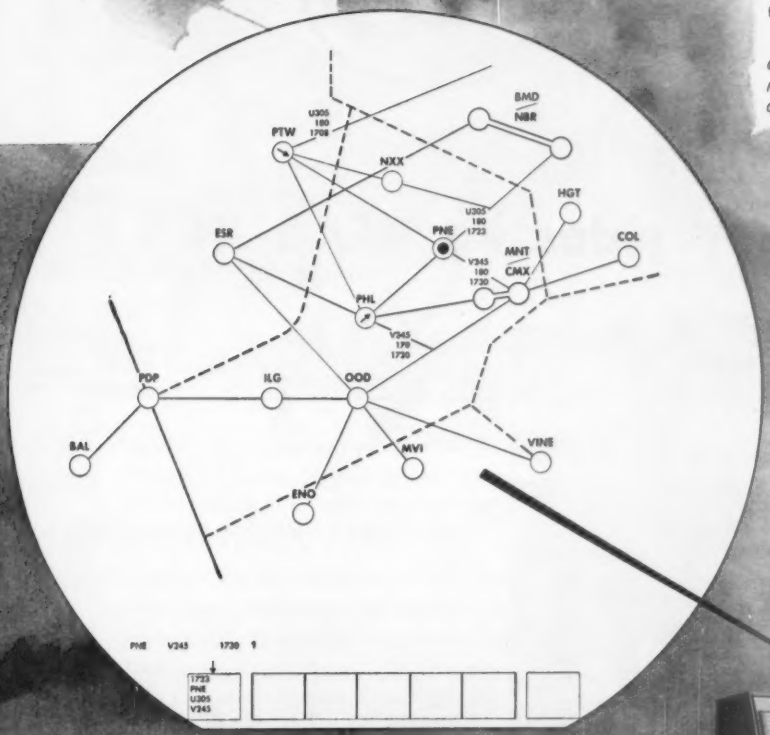
equipment for the Federal Aviation Agency

GPL's experience and ingenuity are at work assisting the FAA Bureau of Research and Development in the creation of a modern data processing central, the heart of tomorrow's air traffic control system. The central will receive up to 400 aircraft flight plans hourly, "remember" 1,000 such plans simultaneously and transmit 200 plans and 800 updates hourly to adjacent centers. Automatic processing and unique displays of such data will make significant contributions to the efficient control of aircraft in en-route, transition and terminal areas.

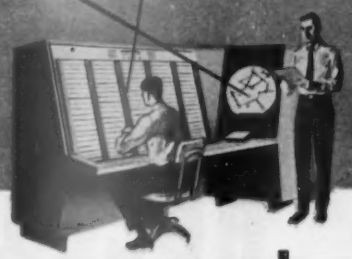
The FAA data processing central is just one of a number of airborne and ground-based programs reflecting GPL's capabilities in the data handling field. These programs are supported by GPL's proven ability to understand the customer's problem and capacity to anticipate future requirements. The GPL organization is "systems oriented," offers complete capabilities ranging from research, engineering and manufacturing to customer service.

Why not put these broad capabilities to work on your problem?

GPL Avionic Division/airborne navigators/missile guidance/ radar/airborne computers/data handling systems/ communications equipment/infra-red/closed-circuit TV.



- AIRCRAFT—COMMERCIAL PRIVATE, MILITARY
- ADC, SAGE, SAC
- MILITARY OPERATIONS OFFICES
- MILITARY TOWERS
- MILITARY-CIVIL RAPCON
- WEATHER BUREAU
- AIRLINE DISPATCH (RADIO) OFFICES
- CAA TOWERS
- AIR TRAFFIC COMMUNICATIONS STATIONS (ATCS)
- ADJACENT ARTCCS



ENGINEERS — GPL achievements have opened some unusual research and development opportunities. Send resume to Personnel Director.

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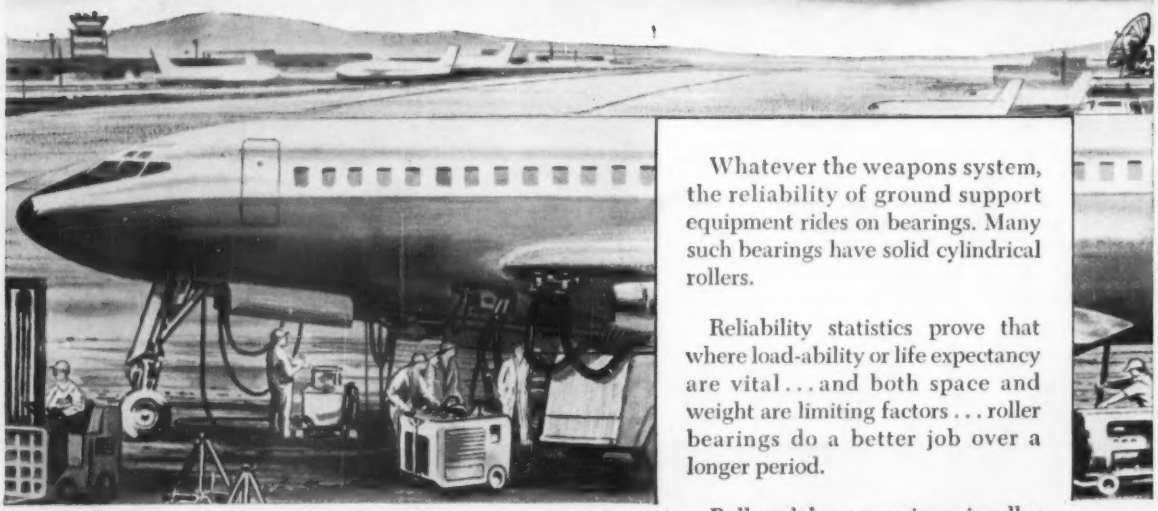
On the Ground as in the Air...

RELIABILITY rides on BEARINGS



Whatever the weapons system, the reliability of ground support equipment rides on bearings. Many such bearings have solid cylindrical rollers.

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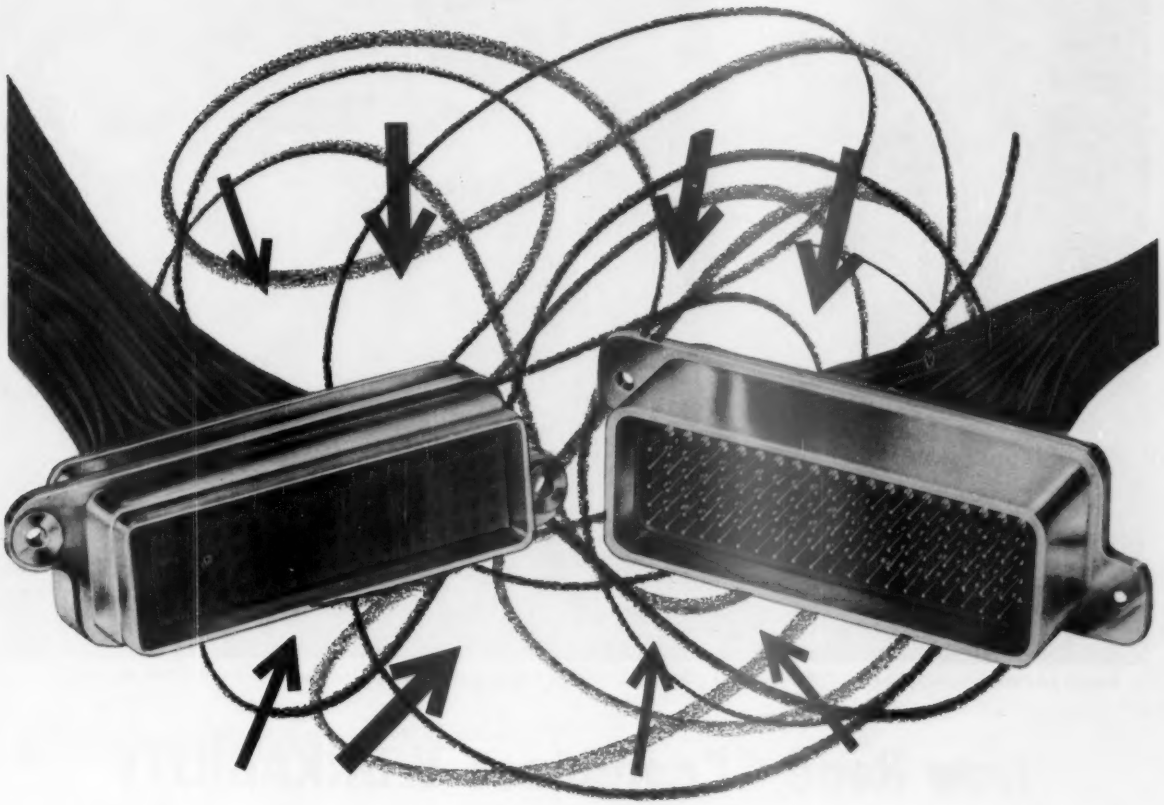

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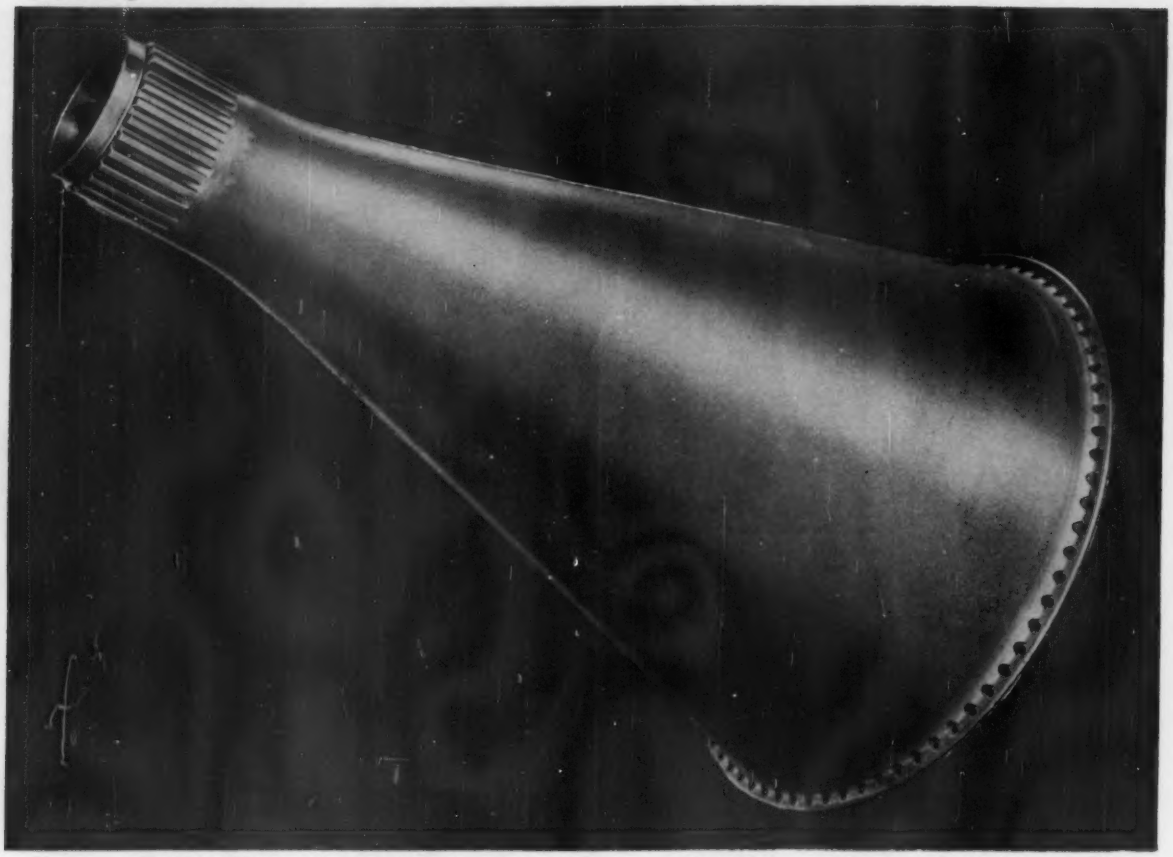

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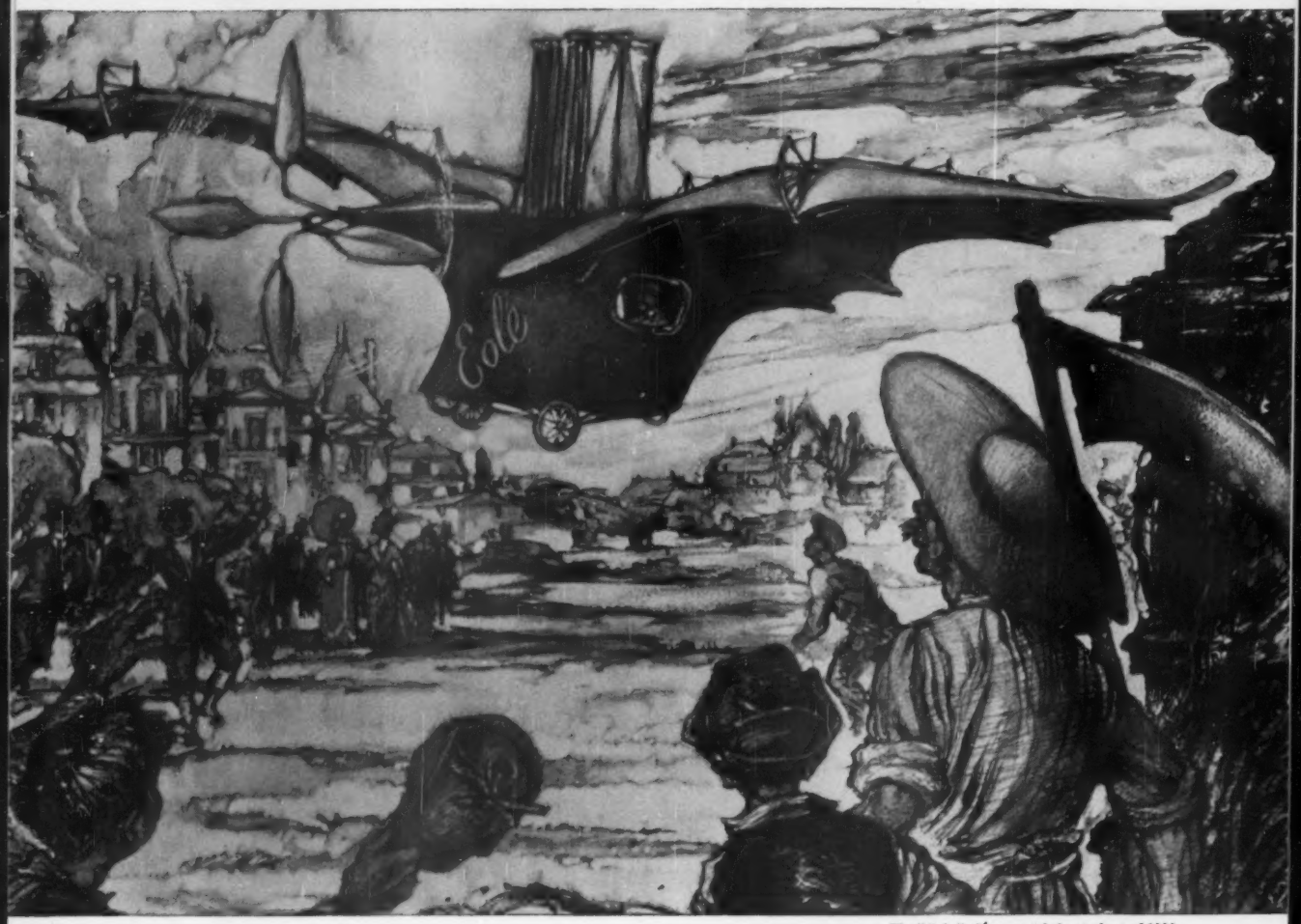

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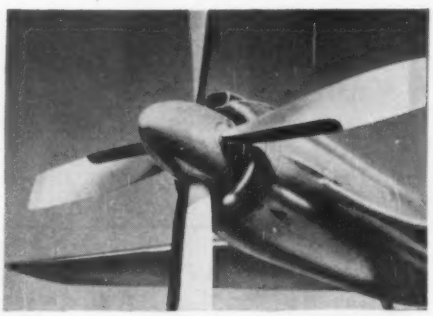

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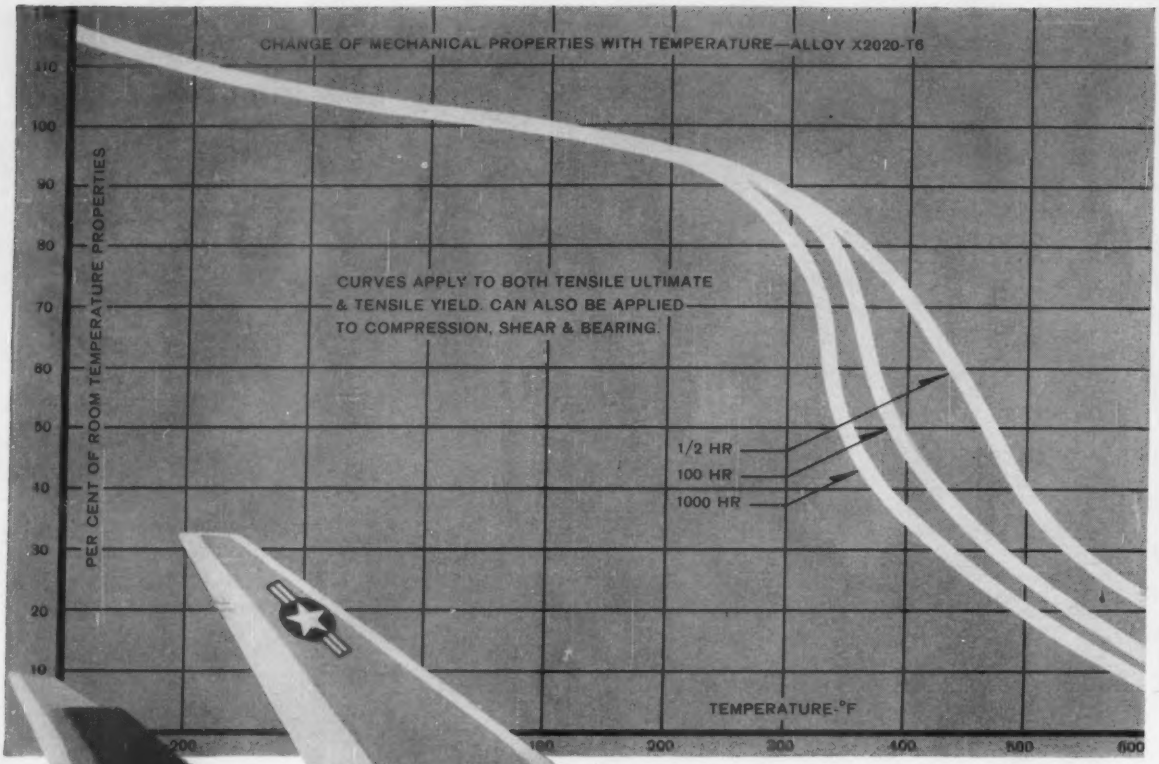

NORTH AMERICAN TRIMS VITAL POUNDS FROM VIGILANTE WITH ALCOA X-2020 ALLOY

THE EXCEPTIONAL high strength and stiffness of Alcoa's new lithium-aluminum alloy permit North American Aviation, Inc., to trim 168 lb from the Navy's A3J *Vigilante* weapon system. Substitution of X-2020 for the alloy previously used allows additional skin milling of the *inboard wings and horizontal stabilizers* to reduce thickness and weight.

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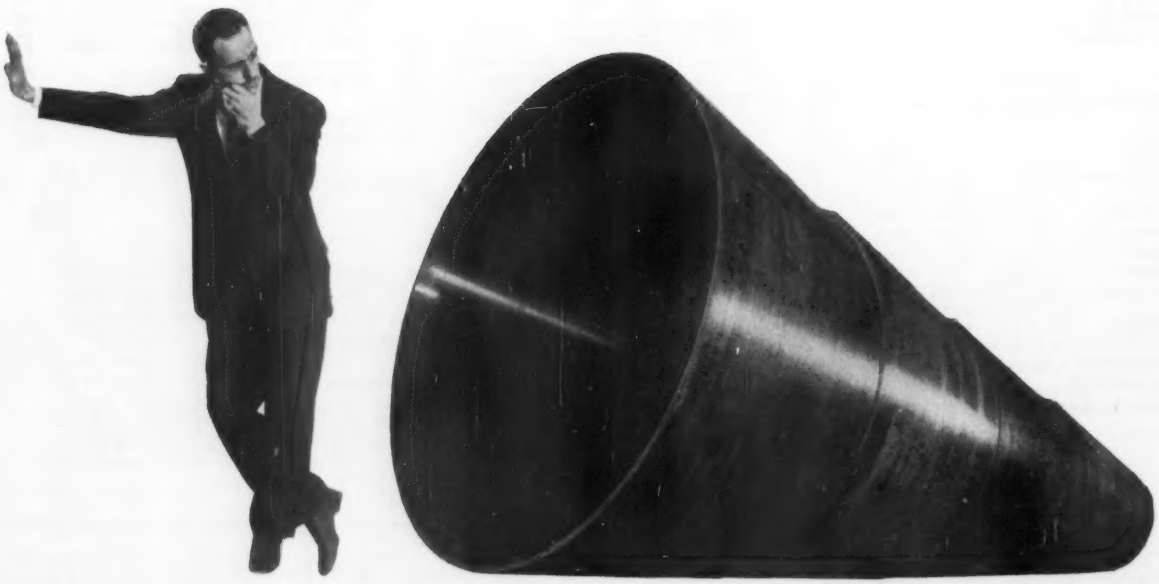

EDITORIAL

Transition in Tokyo

The crisp, sunny days during the fifteenth annual general meeting of the International Air Transport Assn. and the blazing whirl of colored neon signs that turns downtown Tokyo into a nocturnal rainbow may already be fading from the minds of delegates now scattering around the world to their homelands. But two memories will remain for a long time to come in the hearts and minds of all those attending this historic session.

The first is the gentle, warm and truly magnificent hospitality extended by the official host, Japan Air Lines, through its president, Seijiro Yanagita. The second is the unmistakable feeling that this meeting is a historic milestone in the transition of international airline business into a new technical and economic era.

This feeling of transition included both internal IATA affairs, where younger heads of member airlines are rebelling against domination by the IATA staff and the unchanging faces of the executive committee, which is confined primarily to large airlines and senior-statesmen types, and the external impact on the air transport industry of the technical effects of jet operations plus a new approach to economics which this makes vital for survival.

Nobody could come away from the IATA Tokyo meeting without the firm conviction that the basic character of the airline business is changing radically and that these changes are coming faster than most airline executives realize or will admit. Indicative of the feeling of younger, more aggressive airline executives regarding the future issues of their business, was the address of retiring IATA president J. R. D. Tata, chairman of Air India International, who injected a humorous note and incisive comments that were indeed refreshing in proceedings that have become overstuffed with pomposity.

Major Issues

Mr. Tata spoke squarely on most major issues facing this IATA meeting. His remarks on the fare issue certainly reflected the majority opinion of the Hawaiian traffic conference that lower fares are inevitably coming but that it would be prudent to adjust them downward in line with the economic realities of the geographic regions involved. He also made passing reference to the variety of IATA members, ranging from high-cost, heavily-subsidized government corporations to those "recognized as being as lean and aggressively efficient as any transport operator in the world." The significance of this reference did not pass unnoticed by veterans of the Hawaiian fare battles.

Mr. Tata also emphasized that even these "lean and aggressively efficient" airlines were having difficulty in making anything but extremely thin profit margins from current operations. However, Mr. Tata made it clear that lower fares must be a future characteristic of the international airline industry and can be achieved through "coordinated efforts among the carriers and aircraft and engine manufacturers." Such efforts, Mr. Tata said, should be aimed primarily at reducing fuel consumption and maintenance costs, increasing the life and utilization of flying equipment, pooling resources to minimize duplication expenditures and, wherever possible, avoiding the highly wasteful excess capacity offered today on many world air routes.

This technique, pioneered by the European Air Union, in pooling the resources of a combination of smaller airlines to finance, operate and maintain jet transports, is a major future trend in international airline business and will basically change the character of corporate structures and nationalistic policies during the next decade. For, as the advent of multi-million-dollar, fuel-gulping subsonic jet transports has forced this pattern of regional pooling for gas turbine operations among the smaller carriers, so will the advent of supersonic jet transports force similar arrangements on even the biggest globe-girdling giants in IATA today.

Mr. Tata also faced the problem of supersonic jet transports with that combination of optimism flavored with realism that is required to stay competitive in this business. He noted that the prospects of traveling 2,000 mph. would bring such immense benefits to mankind in promoting trade, travel and communications that "in my view nothing should be done to discourage or retard such a phenomenal step forward."

At this session, the IATA technical committee headed by Sanford Kauffman, of Pan American, took the first historic step to realistically study the technical problems of supersonic transports to be ready for their operational advent a decade hence. It is worth noting that IATA technical studies of subsonic jet transports began just a decade ago, and, although many technical operational problems with this type aircraft are still not universally solved, this patient, detailed work over the past 10 years laid the foundation for the success of initial jet airline operations across the North Atlantic and on key globe-girdling routes.

Supersonic Transport Future

Another indelible impression remaining with those attending the IATA Tokyo meeting is what a tremendous postwar impact air transport has had on the Pacific basin and what a revolutionary effect jet transports will have in shrinking the vast expanse of the Pacific area and whittling stage length times between major cities. Most delegates traveled from 6,000 to 8,000 mi. to attend this meeting, a feat impossible without the old-fashioned piston-powered air transport. Already, the Boeing jets of Pan American and Qantas are cutting these travel times in half to a point where Tokyo is as close in travel time to California as was Hawaii in the DC-4 era.

Mr. Yanagita made an eloquent plea to IATA delegates to understand the significance this new role of air transport has for the Pacific basin in bolstering economic, cultural and political ramparts of free Asia and casting aside the insular isolation of the Asian peoples, in the past, fostered by the long, difficult communications with other economic areas. "Today East is West and West is East and no man can say where one actually begins and the other ends."

And so the fifteenth IATA general meeting has been unusually profitable in illuminating the future trends of the international airline business for those who care to see: continued reduction of fares in relation to lowered operational costs and the size of the potential traffic pools to be tapped; regional pool operators of jet equipment in Europe, Africa and Asia plus the Commonwealth bloc; a change in airline attitude on supersonic jet transport from "if" to "when" and the laying of the first technical foundation for its introduction, and, finally, a clear vision of the vital role the jet transport will play in the vast Pacific area. Truly it was a memorable meeting.

—Robert Hotz

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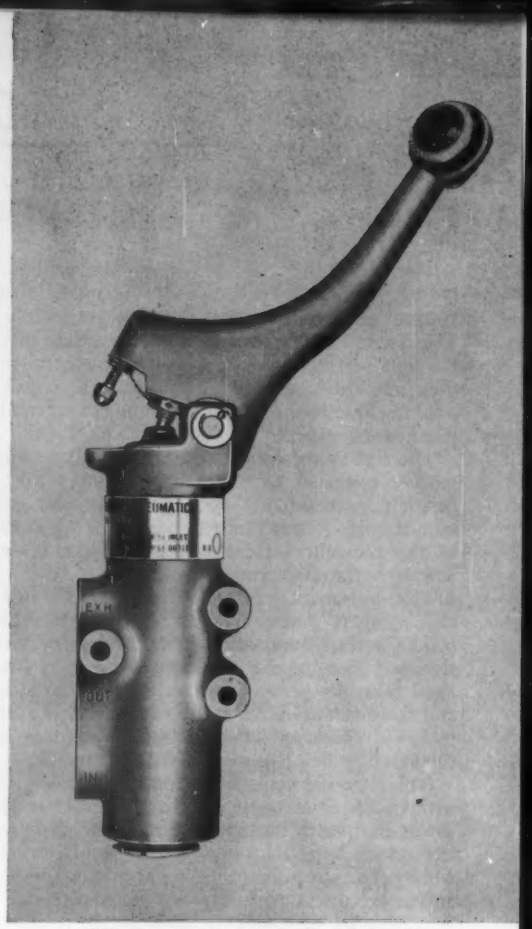
Kidde lever dual brake valve (Installed on F-27, de Havilland Caribou, and Howard Ventura)

Kidde handwheel-operated brake valve (Installed on Convair 880 and 600)



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In the Front Office

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James S. Laidlaw, vice president and general manager, Hycon Mfg. Co., Pasadena, Calif., succeeding **William T. Snebold,** resigned. Mr. Snebold continues as a director. **Edmund W. Baker** succeeds Mr. Laidlaw as vice president-engineering and chief engineer.

Dr. Robert E. Beam, vice president-research and development, Hallicrafters Co., Chicago, Ill. Dr. Beam is professor of electrical engineering at Northwestern University.

John H. Mahoney, vice president-marketing services, Capital Airlines, Inc.

Hershel Toomin, president, Solidtronics Corp., Panorama City, Calif., a newly established division of Electrosolids Corp.

Jules M. Kleinman, president and director of engineering, Mini-Rad, Inc., North Hollywood, Calif.

George A. Strichman, president, Kellogg Switchboard and Supply Co., Chicago, Ill., a division of International Telephone and Telegraph Corp.

Alanson W. Parkes, Jr., president, Ballantine Laboratories, Inc., Boonton, N. J. Also: **Frank Zayac,** executive vice president and general manager.

Benjamin H. Ciscel, senior vice president and director, Electronic Specialty Co., Los Angeles, Calif. **Rollin M. Russell** succeeds Mr. Ciscel as executive vice president and director. Also: **Dr. James A. Marsh** and **Richard H. DeLano,** directors; Dr. Marsh is president and Mr. Delano executive vice president of Systems Laboratories Corp., recently acquired by Electronic Specialty Co.

Edwin R. Gamson, a vice president, Telemeter Magnetics, Inc., Los Angeles. Mr. Gamson is general manager of the Components Division.

B. P. Gibbons, vice president-sales, Altamil Corp., El Segundo, Calif.

Noah Dietrich, board chairman, Houston Fearless Corp., Los Angeles, succeeding **Richard Woike** who continues as a director and chairman of the executive committee.

Honors and Elections

The American Society for Metals has named **John L. Atwood,** president of North American Aviation, Inc., recipient of the society's Medal for the Advancement of Research. Under Mr. Atwood's leadership, North American has led in the development of chemical milling and electrochemical milling, and pioneered in the use of titanium and in such advanced forming methods as explosive forming, the Society said.

K. E. Van Every, chief of the aerodynamics section of Douglas' El Segundo Division, has been awarded the Society of Automotive Engineers' Wright Brothers Medal for his engineering review, "Design Problems of Very High Speed Flight."

(*Continued on page 150*)

INDUSTRY OBSERVER

(The following Industry Observer column was compiled and written by the Aviation Week editorial team covering last week's triennial inspection of National Aeronautics and Space Administration's Langley, Va., Research Center:)

▶ National Aeronautics and Space Administration's Project Mercury pilots have made substantial changes in the original layout of the Mercury capsule instrument panel, which is now close to final configuration. Power limitations of the capsule's battery system will keep instruments relatively simple and bar use of cathode ray tube displays and other sophisticated approaches developed in the various integrated instrumental panel programs.

▶ **Power and weight limitations have dictated elimination of one of the earth-sky cameras planned for the Mercury capsule, but the pilot will have one multi-purpose camera he can operate manually. Doctors insist upon including a camera for a closeup record of the pilot's facial reactions in addition to the camera carried to record instrument panel readings. Mercury pilots are gradually acquiring the technique of controlling the capsule with the three-axis sidearm controller, but the feeling persists that NASA should continue to study the advisability of restoring yaw control to the foot pedals common to aircraft. Use of foot pedals probably would increase capability for simultaneous control motions and reduce chances of cross-coupling in control motions.**

▶ Escape system on the Mercury capsule is triggered by pressing an unlocking button and moving a sidearm control stick held in the pilot's left hand.

▶ **National Aeronautics and Space Administration's Goddard Space Flight Center is preparing a sounding rocket payload with optical sensors to study the unexplained ultraviolet nebulae discovered two years ago by sounding rockets launched to measure brightness of the stars in the far ultraviolet portions of the spectrum. Payload will be launched from Wallops Station, Va., this winter with an Aerobee-Hi rocket.**

▶ Scout space research rocket is now expected to be flight-tested at NASA's Wallops Station late this year. Delta vehicle, which is a modified Thor Able, is expected to get its first flight test at about the same time at the Air Force Missile Test Center, Cape Canaveral, Fla.

▶ **Moulding of an individually-fitted couch for a Mercury capsule pilot requires him to lie on his back for two hours in a bed of quick-hardening sand. Nitrogen is forced through the sand under pressure to speed hardening.**

▶ Argon-atmosphere fusion welding process is used to join inner and outer skins of the Mercury capsule and for a number of other applications in capsule construction. Inner skin is built up with stringers and bulkhead rings. Outer skin or radiation shield attaches to these stringers.

▶ **Jettisoning of antenna housing lid and deployment of drogue parachute on the Mercury capsule are both accomplished with explosive charges. After the drogue chute has stabilized the capsule, the antenna canister is separated from the main body of the capsule, pulling out the main parachute. In capsule tests using the Little Joe booster, the main parachute is deployed above 1,000 ft. altitude. A backup chute could be used if first one failed.**

▶ Mercury pilots now have the use of four aircraft with which to maintain their flying proficiency while they train for their orbital missions. In addition to two Lockheed T-33s, they now have two Convair F-102s from which the armament has been stripped. F-102s are assigned to National Aeronautics and Space Administration by USAF and maintained by an Air Force unit at Langley AFB, Va.

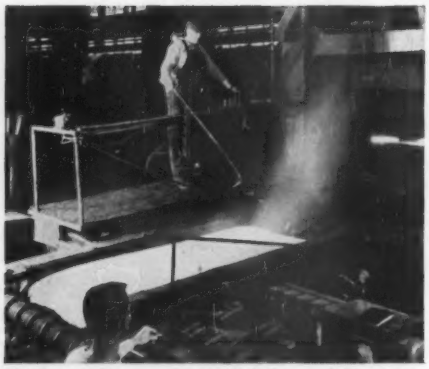
▶ **NASA has selected a frequency of 2,400 mc. for its passive communication satellite tests. Industry and private experimenters will soon be given full technical details in an effort to encourage them to participate in passive communication satellite tests on a voluntary basis.**

High Strength–Light Weight for use up to 2000°F.

Honeycomb construction and paper-thin foil made of HAYNES alloys have teamed up in the battle against the thermal thicket. The result? a strong, lightweight material that resists temperatures in the 2000+ deg. F range. A material that enables engineers to design parts with exceptional heat-resistant characteristics and with high strength to weight ratios; components that equal the high-temperature resistance of solid sections, yet weigh only 1/10th as much.

Foil as thin as 0.002 inch is now available in HAYNES alloy No. 25, HASTELLOY alloy X, and MULTIMET alloy. It can be obtained as foil, for use in engine blanketing for example, or in honeycomb form.

HAYNES high-temperature alloys are produced in many other forms, too. Sheet, plate, bar stock, wire, tubing, and castings are all immediately available. For full information, write for descriptive literature.



High quality and availability of HAYNES wrought alloys are assured because they are produced in our own plant by experts. Sheet, above, is being hot-rolled on a 3-high mill.

HAYNES
ALLOYS
HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

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Washington Roundup

Curtiss-Wright Quits AIA

Curtiss-Wright Corp. announced its resignation last week from the Aerospace Industries Assn. and the Manufacturers Aircraft Assn. touching off a mild controversy between Roy T. Hurley, Curtiss-Wright president, and Orval R. Cook, president of AIA.

Hurley declared that he has become convinced that "the defense of our country, as well as the welfare of taxpayers and stockholders, will be better served if each company operates independently in as many areas as it can afford or has the qualifications to do so. By so doing we can compete more successfully in world affairs and minimize the inflationary effects of a large defense program."

Cook retorted that he regretted Curtiss-Wright's resignation and added: "Under prevailing complex conditions, our members believe there are many areas, and especially in the technical field, in which group action is necessary both to the defense establishment and to industry."

Cook said he had expected the Curtiss-Wright resignation and noted that "it had increasing interests in fields other than those served by our association."

Hurley, on the other hand, emphasized that Curtiss-Wright is not withdrawing from the aviation industry. "On the contrary," he said, "we feel that a program of independent action on our part will provide a stimulus that the industry needs at this time."

Decision Delay Rapped

Defense Department delay in closing production facilities at two new boron fuel plants (AW Aug. 17, p. 26) was sharply criticized in a report issued by the House Science and Astronautics Committee staff.

The report agreed that the services were justified in terminating programed production at the two five-ton-a-day plants at Muskogee, Okla., and Buffalo, N. Y., but charged that the Defense Department was slow in recognizing changing defense requirements and that, as a result, total costs of the program were substantially increased. Blame for the delay, it said, rests on "the whole cumbersome process of decision-making progress in the Department."

Technology and Politics

Science and technology will enter the 1960 national election campaign as major planks in the platforms of both Republican and Democratic parties. Outlook is that the emphasis will be placed on their ability to ensure "peace" and promote an ever-rising "high standard of living."

The Republican National Committee, in a 15-page report recently drafted by its "task force on science and technology," mentions the research and development work needed to sustain the nation's military stature only incidentally. The group is headed by Charles H. Percy, president of Bell and Howell, manufacturer of movie cameras.

The Democratic National Committee, in a report by its 17-member "science and technology committee," emphasizes as its first proposal the need for the establishment of a new independent agency to study the complex technical problems involved in disarmament. Dr. Ernest Pollard, head of the Biophysics Department of Yale University and chairman of the group, said the agency would act as a laboratory for the active study by "first class" scientists of problems such as the detection of atomic explosions with seismographs or reconnaissance satellites.

ALPA Endorses Radar Plan

Air Line Pilots Assn. last week urged adoption of a Federal Aviation Agency proposal to require airborne weather radar on all scheduled four-engine airliners but said the proposal should be expanded to include all scheduled airline aircraft carrying passengers or cargo. The airlines already have voiced strong opposition to the FAA plan (AW Oct. 12, p. 47).

Suggested amendment submitted to FAA by the pilots' union would make radar use mandatory on all aircraft weighing in excess of 12,500 lb., including the Douglas DC-3 which make up the bulk of the local service airlines fleet and which would be excluded in the FAA proposal as it now stands.

Declaring that it has urged such action for many years, ALPA said an evaluation of the radar units by pilot members indicates the use of radar has improved both the safety and efficiency of operations in areas of suspected turbulence, heavy rain and hail. To substantiate its position, ALPA submitted a list of 59 aircraft accidents involving both twin- and four-engine aircraft over a period of seven years, in which turbulence was suspected as being a factor.

The Air Transport Assn., in its reply to the FAA proposal, questioned the basic need for a mandatory regulation and said that, if adopted, the plan could inflict serious operational and economic hardships on the airlines. The FAA action was touched off by a Capital Airlines Viscount turboprop accident near Baltimore in May which appeared to have resulted from the aircraft entering an area of turbulence with its radar inoperative (AW May 18, p. 41).

Khrushchev's Helicopter

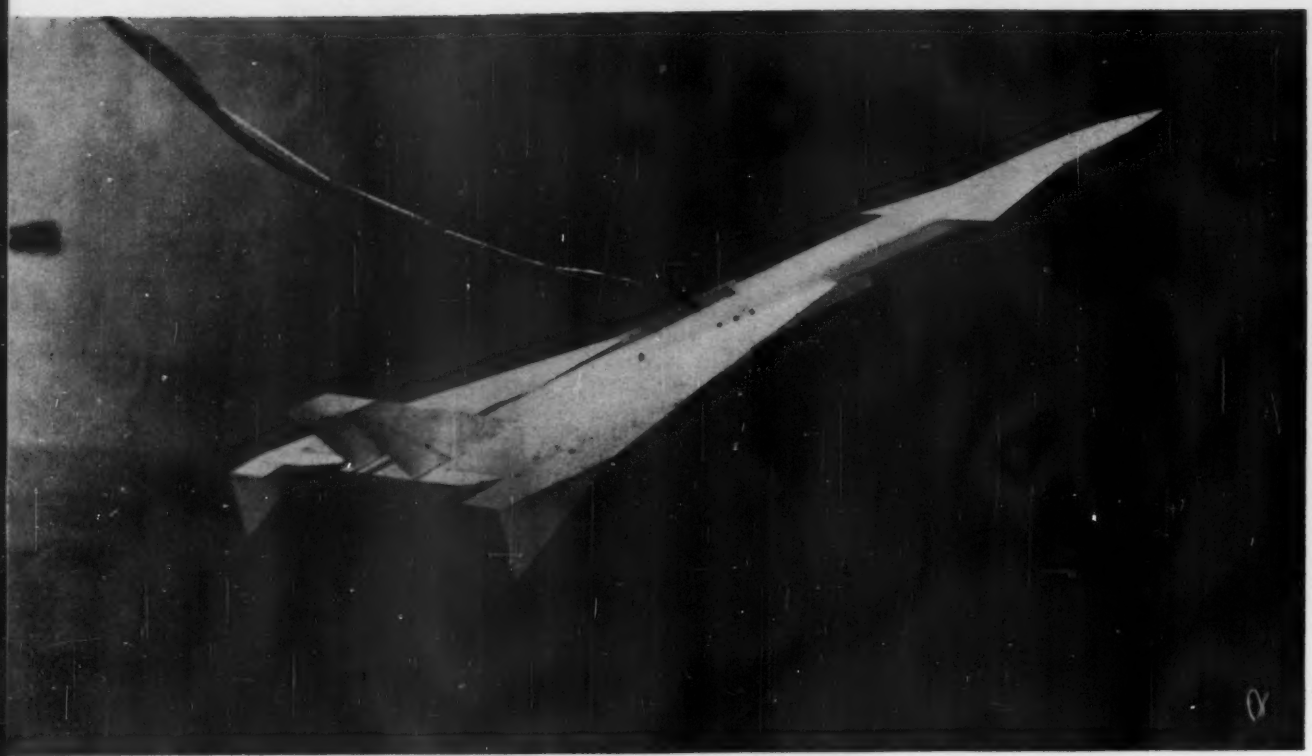
United Aircraft Export Corp. now is calculating the costs of all the trimmings and trappings that will be needed to make a Sikorsky S-58 helicopter identical with the one used by President Eisenhower to fit the desires of Soviet Premier Nikita Khrushchev. Khrushchev rode the President's aircraft during his recent U. S. visit, despite the warnings of Soviet advisers that helicopters are not very safe, admired it, and commented, "I'd like to buy one . . ." The Soviet Embassy promptly took the matter up with the State Department, and opened negotiations for the purchase of three S-58s with United Aircraft (AW Oct. 12, p. 39). United, however, could not immediately set an export sales price for a specially-equipped helicopter such as the one used by the President.

Space Strategy Revealed

There is this sign on a Pentagon bulletin board:

"Although Soviet Russia leads the U. S. in rocket propulsion, the U. S. maintains its lead in such vital areas as miniaturization. Otherwise, it could not have succeeded in building a space program so much smaller than the one Russia has."

—Washington staff



MODEL based on an early configuration of the North American B-70 Mach 3 bomber being tested for dynamic stability and control characteristics indicates wing planform for the airplane. Note the folding wingtips (AW Sept. 7, p. 35). Model is 1/20th scale.

Space Technology

NASA Probes Manned Re-entry Designs

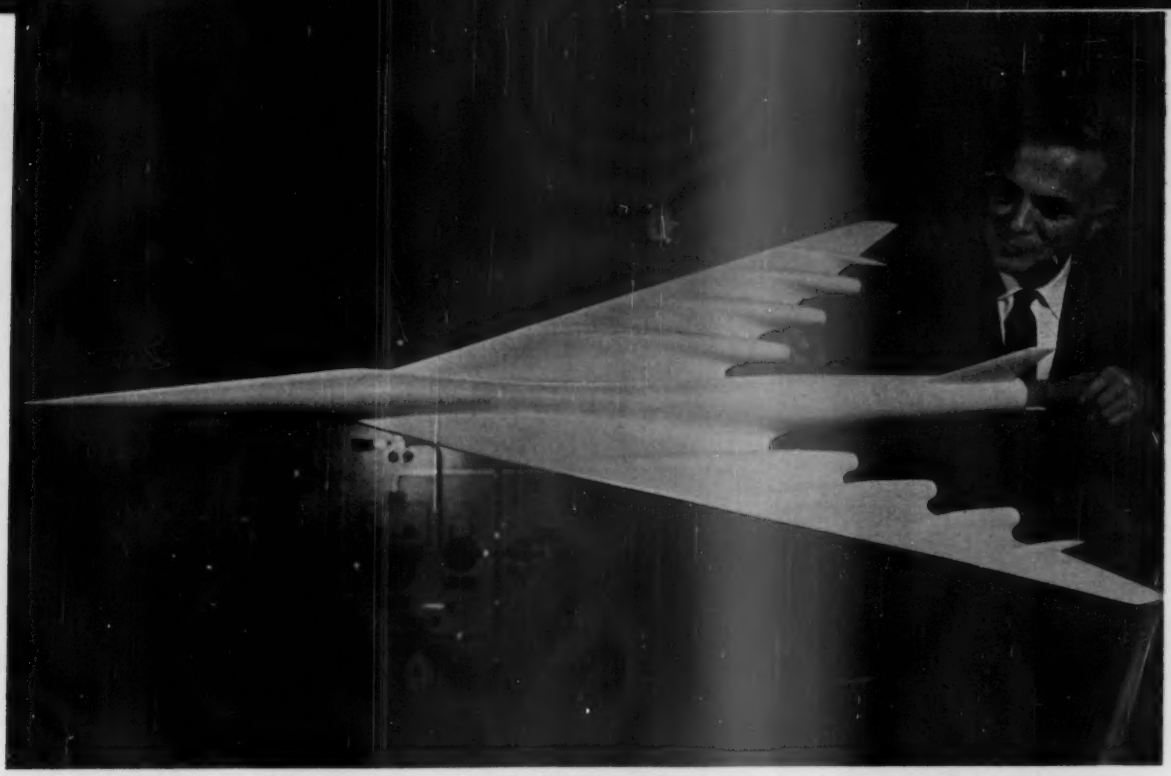
JET-FLAP canard configuration is tested with free flight model. Jet exhaust is deflected upward by tailpipe extensions against wing and flap to increase lift greatly.

Langley Field, Va.—Problems of manned flight continue to dominate the research pattern of the National Aeronautics and Space Administration, although emphasis has shifted sharply from atmospheric flight toward space applications during the past year.

This shift was clearly evident last week at the 1959 inspection of NASA's Langley Research Center, the first public tour of an NASA laboratory held since the agency was created a year ago. Langley was the oldest of the three laboratories acquired from the predecessor National Advisory Committee for Aeronautics.

Marked reorientation towards space projects has dramatically broadened the spectrum of environments and conditions involved in manned flight research, which now extends from ground effect and VTOL machines through hypersonic transports and orbital flight to interplanetary travel.

Although the Project Mercury man-in-space program is the best known of the manned flight programs, NASA also is investigating a number of other forms of re-entry and space vehicles as well as the power and communications



DRAG REDUCTION for a Mach 2-3 transport utilizes area rule fuselage and engine nacelles mounted at rear of the wing to create bulges (AW July 14, 1958, p. 49). NASA's Richard T. Whitcomb, who discovered the area rule and later modified it to transports, is shown with a 6-engine model in Langley's 8-ft. transonic tunnel.

problems associated with them.

Manned re-entry vehicles are receiving strong attention from NASA, and a wide variety of designs are under study. Operational usefulness of each basic design depends upon the successful development of new high temperature structural techniques as well as aerodynamic behavior of the designs in all flight regimes from hypersonic through subsonic. A combination of those configurations may prove most desirable since some have great flexibility in their application.

Re-entry Designs

Basic designs under consideration are:

- **Inflatable vehicles** with very large wing areas, providing wing loading of possibly one pound per square foot.
- **Collapsible wings** resembling kites which are stored in small cylinders during launch and are extended for flight in the upper atmosphere.
- **Variable geometry vehicles** with triangular planforms which re-enter the atmosphere at a 90 deg. angle of attack. Horizontal control surfaces are folded onto the back of the aircraft during the maximum heating period and extended for low speed flight when the nose is lowered to conventional angles of attack.
- **High-performance gliders** with high lift-to-drag ratios resembling current delta wing aircraft.
- **Gliders with highly rounded** leading edges to reduce local heating but gen-

KITE-LIKE structure which might be used as an auxiliary wing to reduce landing speeds of supersonic transports would be collapsed and stored in compartment on top of the aircraft.

STORABLE 6,000-lb.-thrust liquid rocket (full-size cutaway at left) will be third stage of Vega rocket vehicle. Flight package of a 100-ft. sphere is at right; NASA would launch sphere as a relatively small package that would inflate automatically in space.

erally similar to the one described above. These may prove to have more operational flexibility and range in high heating situations.

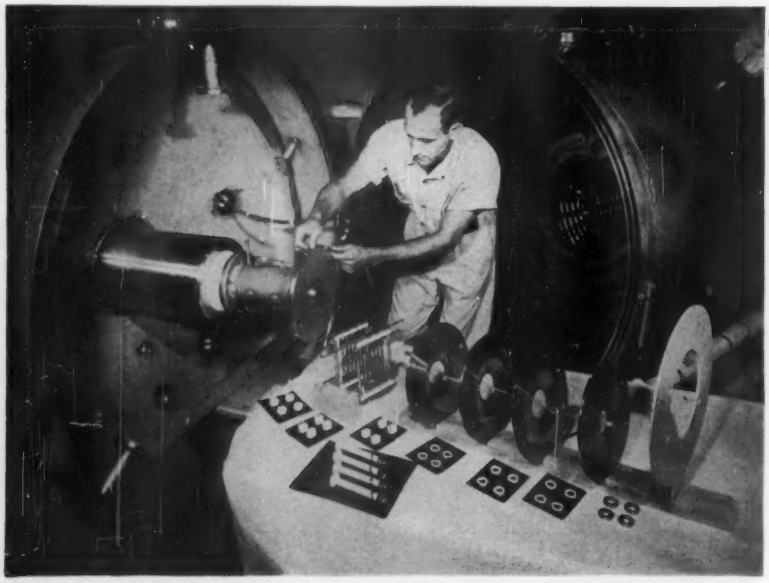
• **Modification of Mercury-type** ballistic capsules with flat tops that can develop some lift.

• **North American X-15** research vehicle which is under continuing study for possible use at much higher speeds than specified in the original design.

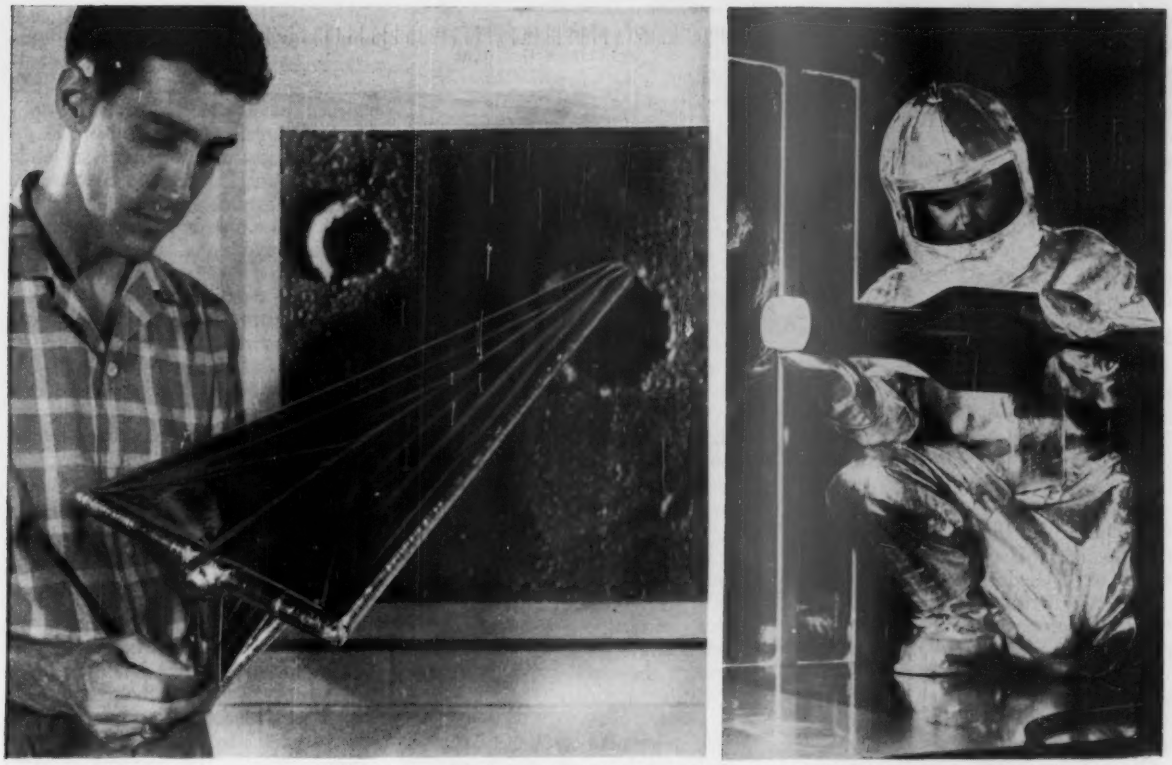
Inflatable and collapsible aircraft would alleviate two main problems of orbital vehicles, one at great altitude and one at launching. There is a stability problem at launch that comes from placing a large rigid structure with wings on top of a slender ballistic missile which would be eliminated if the wings could be collapsed. High altitude performance of a re-entry vehicle would be greatly increased as would the performance of any aircraft if the wing loading could be lowered to one or two pounds per square foot. NASA believes that this may be achieved with inflatable wings.

A 10,000 lb. re-entry glider, for instance, would have a wing area of 5,000 to 10,000 sq. ft. and could begin to slow down somewhere near 300,000 ft. altitude with its aerodynamic heating greatly reduced. The structural material of the inflatable glider would be much less resistant to heat, however, than a solid structure. Significant progress already has been made with inflatable structures and with their stiffness and resistance to flutter and with their capacity to withstand moderate heating. The present opinion is that such structures could be used for very high altitude re-entry.

The collapsible vehicle models demonstrated by NASA had three stiff poles in the streamwise direction with flexible material connecting them. They resembled kites when the flexible material ballooned out and provided a lift-producing curved surface. Similar kites might be used to increase the lift of orbital vehicles during landing as well



RESEARCH MODEL of ion engine that operates with cesium as a propellant is assembled at NASA's High Vacuum Test Facility at Lewis Research Center, Cleveland, Ohio.



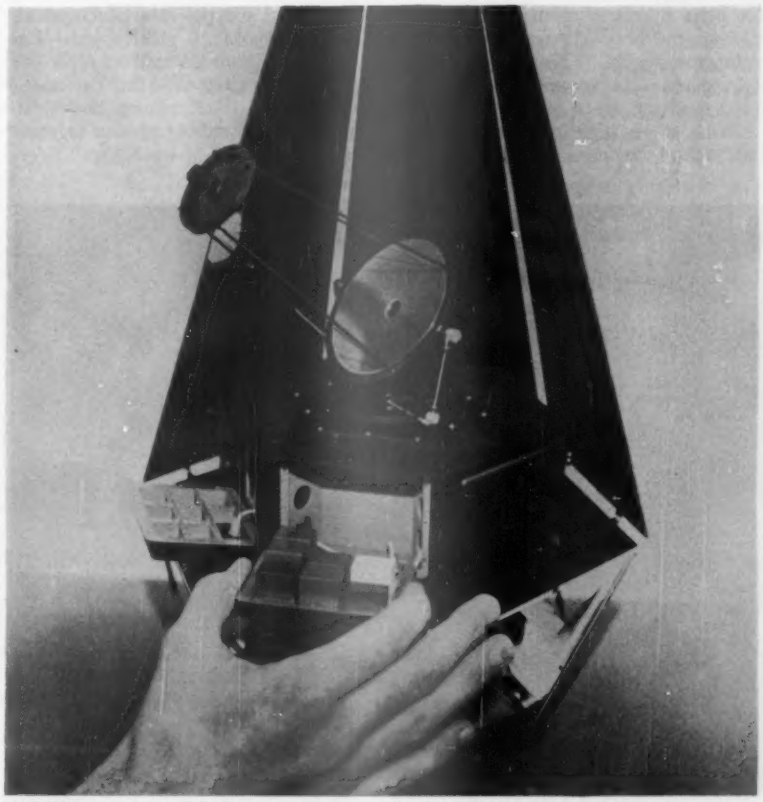
PROPOSED foldable space vehicle (model at left) would be made of thin layers of aluminum foil and plastic film to obtain data on penetration damage of micrometeorites. Full-scale plastic model of rocket motor (right) is tested for stability in wind tunnel.

as re-entry phases of the flight.

Variable geometry vehicles of solid construction which would retract large control surfaces out of the main floor during re-entry also are being considered by NASA. Landing would be greatly aided when these surfaces are extended, but during the hypersonic speed range when they traveled at very large angles of attack, they would have many of the characteristics of a ballistic capsule.

Success of the research work on high-strength heat-resistant and cooled structures will eventually determine whether these vehicles will be needed. If this research effort produces usable results rapidly, the first winged re-entry vehicle, probably will resemble modern fighters. NASA has constructed large scale structural models of hypersonic gliders which probably will be satisfactory for re-entry heating periods up to 20 min. Many expansion joints, insulating layers and structural members filled with water are typical features of these structures which can withstand maximum outer surface temperatures of 2,500F and 1,200F on the load-carrying members.

The wing leading edges are the main problem today, with their temperatures going above 3,000F. Refractory members, graphite ceramics and ablating materials are being considered for this use. The bluntness of the leading edge



ONE-SIXTH scale model of proposed Mars payload for **Vega vehicle has six avionic chassis** on hexagonal base. Two chassis are shown opened, below infrared spectrophotometer.

will be a direct indication of the structural engineer's success in his research. If he is very successful, the leading edges can be nearly as sharp as those on supersonic fighters and still withstand re-entry heating and land well. In this case, it will not be necessary to think of inflatable vehicles. The blunter the leading edges of re-entry gliders must be to withstand the heat, the more attractive variable geometry, collapsible and inflatable vehicles become.

Space Propulsion

Space propulsion systems of the three basic types—electrical, nuclear and chemical—are now being studied under NASA programs. Electrical systems such as ion and plasma engines using nuclear reactors for power have generally appeared to be more economical than chemical rockets for trips beyond the moon. This conclusion, however, has been opened for re-evalution following the discovery of the great radiation belts around the earth. In the past, shielding weight on the electrical vehicles was proposed to be kept to a minimum by placing the nuclear reactor 100 ft. or more from the crew and using a shadow shield.

Now, heavy all-around shields would have to be used to protect the crew and vital equipment as the vehicle accelerated for many days through the radiation belts near the earth in order to build up the necessary velocity for interplanetary flight. This added weight might destroy the economic advantage of the electrical space vehicle.

Lifting it to high orbit above the earth before beginning its interplanetary trip also would affect the electrical vehicle's advantage over a rapidly accelerating chemical rocket that could leave a low orbit and pass quickly through the radiation belts.

National Aeronautics and Space Administration's 1959 inspection tour of its Langley, Va., Research Center was covered by an Aviation Week team of space technology editors Evert Clark and Craig Lewis and engineering editor J. S. Butz, Jr.

Research into the basic fundamentals of controlling a high temperature plasma has assumed major prominence at NASA as it has in most research organizations interested in space propulsion and communications. NASA has added a new name to the lengthy list which already exists to describe this new branch of physics. The space agency calls it magnetoplasmadynamics in contrast to magnetohydrodynamics, plasma dynamics, etc., which are used in other quarters.

Nomenclature for this new science appears to be evolving around the mathematical approach used and the broad problem being investigated.

One development of unusual interest in the NASA program is a propulsion device which accelerates a plasma with microwaves. A resonance set up in a microwave channel partially filled with plasma creates a powerful force which expels the plasma at great speeds. Exhaust velocities of 25 million mph. are considered possible with this device.

Production of radio-frequency radiation by firing bursts of plasma together also is being studied by NASA. Very strong signals with a low noise level have been demonstrated with this procedure. A new method of space communication of unprecedented power is believed possible using plasma amplifiers and signal generators.

The plasma sheath that surrounds bodies re-entering the atmosphere at great speeds is being investigated by NASA with a unique rocket system and ground-based plasma jets to determine just how this sheath changes the radar target and cuts transmission of radio signals from the re-entry body and how use of different materials may affect the density of the sheath.

Understanding of this phenomenon is important in missile warhead and decoy detection and tracking, and it becomes increasingly important as velocity of the body increases as it will with re-entering satellites and particularly with vehicles re-entering from interplanetary missions.

Six-Stage Rocket

NASA already has made exploratory flight tests with an inexpensive six-stage solid rocket fired from Wallops Station. First three stages lift the last three—which are called the velocity package—to altitude. It is stabilized in the normal attitude, still pointing upward. There, the three final stages then fire downward through an open tube. The final stage is a spherical rocket motor developed by NASA, which serves as the re-entry body and comes in at satellite speeds. It has been photographed and signal attenuation from an antenna on its nose has been recorded. Massachusetts Institute of Technology's Lincoln Laboratories will assist in future studies.

The same antenna used in rocket flights is bathed in a plasma in an outdoor ground installation to study transmission under simulated conditions. Flight test experiments and theory agree, and NASA hopes that application of relatively simple theoretical approaches will bring understanding of the complex transmission problems.

Directly related is the use of heat protection materials. These must be studied experimentally to determine their effect on the intensity of the ionization. The NASA Scout vehicle, due for testing soon (see p. 23), will fire ablating noses at satellite re-entry and planetary re-entry speeds. Noses will carry ablation sensors to study this problem. While transpiration cooling using some gas such as helium increases in effectiveness with an increase in velocity, it carries weight penalties, and NASA says ablating materials now appear the most promising. Heat sink noses begin to decrease in effectiveness somewhat before 10,000 mph. and are not being considered for extremely high speed ranges.

RESTRAINT HARNESS is attached to couch for a Project Mercury capsule. Contoured couch is fabricated of foam plastic, finished with fiber material after hardening.

Experimental facilities still are entirely inadequate for reproducing reentry flight velocities, making the Scout tests essential, NASA says.

An immediate need exists for surveys to determine the size, energy and distribution of particles in space and for a theory to explain thoroughly the stresses and shock waves produced by high speed impact of space debris with space vehicles, according to NASA researchers.

Satellite and space probe flights are being supplemented in the laboratory, primarily with particle accelerators and light gas guns, at both Ames and Langley Research Centers.

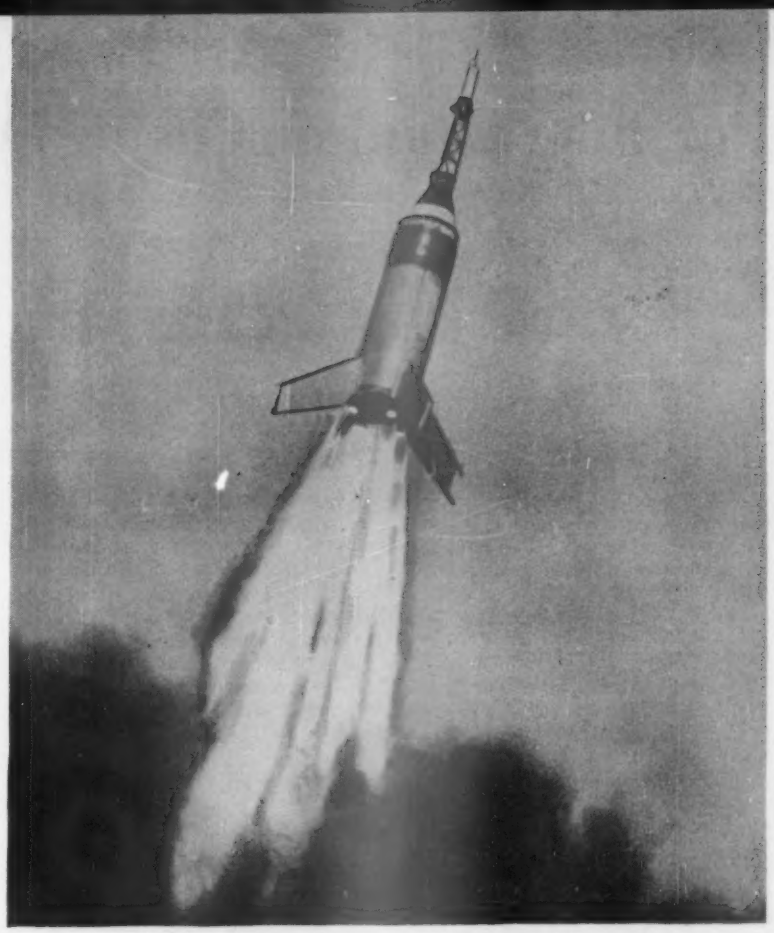
Particles as small as atoms and ions, traveling at speeds up to 2 million mph., can erode reflective surfaces of a space vehicle enough to allow a change in internal temperature that would affect operation of the instrumentation. For short-life satellites, this appears to be no problem, but further exploration is needed to prepare for longer space missions.

Even though their size alone would not present a problem, small meteoroids are hazardous because they travel at speeds from 25,000 to 160,000 mph. and produce explosive cratering effects. Crew compartments, propulsion systems and the large radiators expected to be used on nuclear and nuclear-electric manned interplanetary vehicles are particularly vulnerable. Impact also will be important to the inflatable manned vehicles now being considered by NASA. The Explorer VI satellite has recorded one or two impacts per day on two small plates, indicating that a vehicle large enough to carry a man would receive hundreds of impacts over a 24-hr. period.

NASA has learned that the shielding effectiveness of a piece of satellite shell of given thickness and weight can be greatly increased by dividing it and spacing the layers and by filling the space with a light material that can double as an insulator. Wide spacing permits resistance to particles of about double the former velocity. Wide spacing, with glass wool sandwiched between, allows resistance to particles of almost three times the speed that the skin would withstand if it remained in a single piece.

Highest speeds reached thus far by NASA with light gas guns that accelerate material particles is 14,000 mph. Other researchers are exploring impact phenomena (AW Sept. 14, p. 108) but there is still disagreement, even between the Ames and Langley laboratories, over impact theory.

The Vega space vehicle will make the first use of a unique "parking orbit" technique to overcome the unfavorable location of existing launching sites. This will permit firing toward the moon at any time of the month and a 20% increase in payload.



NASA Fires First Little Joe Booster

First Little Joe booster to be fired in the Project Mercury development program is launched at NASA's Wallops Station, Va. Firing was an operational test of the booster, launching and destruct systems. Boilerplate capsule with inert escape rocket system was not instrumented. The 55-ft., 20-ton booster has an initial thrust of 250,000 lb.

First stage fires and drops away. Second stage fires, putting itself and the third stage and payload into an orbit around the earth and becoming a mobile launching base or temporary space platform from which the third stage can fire.

When the whole assembly is in the proper location and correctly oriented, the third stage fires toward the moon or other space target. If the vehicle were launched from Cape Canaveral, it would not quite complete one orbit of the earth before the third stage fired over Woomera, Australia.

Guidance for the Vega is a modification of an all-inertial Army missile system. In the three-stage version, it will ride above the third stage propellant tanks and will control flight of all three stages.

The third stage, being developed by NASA's Jet Propulsion Laboratory, is 27 ft. long. Hypergolic nitrogen tetroxide oxidizer and hydrazine fuel are fed by a simple cold helium pressurization system to the combustion chamber, which is regeneratively cooled by the hydrazine. Engine is made of spun and drawn stainless steel tubing and produces 6,000 lb. thrust. Second stage engine is the General Electric 405H-2, which is a modified Vanguard engine using Atlas tank components for its propellants. The Convair Atlas forms the vehicle's first stage.

Missions now proposed for the vehicle include 24,000-mi. orbits for meteorological satellites; 1,000-lb. payload lunar passes and lunar orbiting flights; near misses of Venus and Mars with payloads up to half a ton and communications relay satellites in earth orbits.

In the aeronautical field, which once dominated NACA research, NASA is continuing substantial programs in high-speed transport aircraft and in VTOL and STOL techniques. The possibility of rocket-powered transports is considered a dim prospect in the foreseeable future, and NASA is proceeding with research on transonic, supersonic and hypersonic transports with the confidence that airline transports will continue to cruise in the atmosphere and use airbreathing engines.

Pershing Titanium Casing Order Canceled

By Michael Yaffee

New York—Army is canceling its order with Pratt & Whitney for 55 full-scale titanium casings for the Pershing missile and will revert to less-costly steel casings for the program.

Use of heavier steel casings is expected to cut the range of Pershing by 50 mi. and probably will mean other weight compromises.

Decision caused dismay among titanium producers because the Pershing work was considered the most sophisticated and advanced titanium development program to date. The results of this work were expected to unlock the door to large-scale titanium application in the missile and space field.

Economic Considerations

From what can be learned, the Army's decision to go to steel on the Pershing was dictated primarily by economic considerations. At the present time, a full-scale titanium casing for the Pershing might cost 2½ times as much as a steel casing. In production, the cost might drop to 1½ to 2 times that of steel. This factor becomes even more significant when it is considered that titanium casings were being developed for both the first and second stage of the Pershing. Moreover, the Army is believed to be having difficulty trying to find funds for the missile.

There are a number of other titanium programs under way in the missile field today but at the present time none of them is considered in the same class with the canceled Pratt & Whitney project as far as promise and technical attainment.

The Polaris fleet ballistic missile program, which is believed to have encountered difficulties in achieving the desired range, may yet provide the titanium industry with an opportunity to crack the missile field in a major way. There has been a titanium development program in progress for the past two years on casings for the Polaris but, says a group of titanium engineers, it has failed to pay off owing to the contractor's lack of experience in handling titanium.

The contractor, for example, fabricated a casing with a longitudinal seam, which, they say, cannot be done successfully with titanium.

For this reason, among others, companies with experience in the fabrication of titanium are seriously considering making a bid for titanium work on the Polaris.

Aerojet-General and Beech Aircraft reportedly are doing work for the Air Force on the development of titanium containers for the ground storage of liquid hydrogen. One unit is expected to be a sphere 30 ft. in diameter that may have to be constructed on site.

Some titanium will be used in the nozzles of the first production models of the Polaris missiles due principally to the development work Aerojet-General has been doing with titanium.

Hercules Powder Co. has given Curtiss-Wright a contract to develop titanium casings for the third stage of the Minuteman ICBM. Hercules is interested in exploring these as an alternative to the plastic casings now considered for this job. Another company hopes to compete with titanium casings for the second stage of the Minuteman.

Some titanium is going into the Project Mercury capsule, and the metal also is expected to find an application in the Dyna-Soar capsule.

To Pratt & Whitney, which was doing the titanium casing work for Pershing under subcontract to Thiokol, the cancellation means a serious curtailment and, possibly, an end to its participation in the Pershing program. Present plans now call for Pratt & Whitney to make only three full scale titanium casings for the Pershing second stage.

As planned, Pratt & Whitney will supply the so-called interim steel casings for the Pershing. Originally Thiokol, which has the subcontract from Martin for the Pershing. Originally, Thiokol, asked Pratt & Whitney to make a number of steel casings which could be used in the Pershing program until the titanium casings could be developed and produced. The steel casings have been on order for eight months and the first shipment now is in transit to Thiokol. It has not yet been decided which company will get the production contract for the steel Pershing casings.

Although Pratt & Whitney refuses to commit itself on its future plans for titanium, there is a possibility that the company will try to put its titanium experience to use in the Polaris and, possibly, the Centaur programs.

There also is the possibility that titanium will find its way back into the Pershing program. Present plans call for Pratt & Whitney to fabricate three full-scale titanium casings for the Pershing. If test data on these finished casings prove that titanium will live up to the promises it now shows, according to one solid propellant engineer, then there is a chance that titanium casings will be returned to the Pershing and other missile programs now under way.

As far as the missile itself is concerned, the decision to abandon titanium means an increase in total weight of roughly 160 lb., a loss of 50 mi. or more in its maximum range of approximately 700 mi. and, assuming a cut in weight of the warhead, a loss in the over-all effectiveness of the weapon.

Looking at it from a somewhat different angle, some engineers believe that it might even have been possible to extend the range of the Pershing to almost 1,000 mi. by using titanium and taking advantage of "other technological advancements."

On the other hand, the decision to go to steel casings is not expected to cause any delays in the Pershing program. It may, some engineers feel, mean a loss for all practical purposes of the $800,000 or so that the government has put into Pratt & Whitney's titanium casing development program.

On the technological side, titanium seemed to be more than justifying itself for missiles. The Army, Martin, and Thiokol reportedly were more than satisfied with the progress Pratt & Whitney has been making on the titanium casings for the Pershing.

New Alloy

In this particular program, which has been under way for the past year, Pratt & Whitney has been working with the comparatively new all-beta titanium alloy (AW Sept. 1, 1958, p. 37). From the results of this work and its earlier jet engine work with titanium, Pratt & Whitney is convinced it can fabricate full-scale solid-propellant casings from the all-beta titanium alloy with yield strengths of at least 180,000 psi.

For steel casings, the comparable yield strength figure now is 240,000 psi. But high yield strength is not the only characteristic desired in casings. At the start of this program, Pratt & Whitney was asked to develop a rocket casing material that would have a yield strength-to-density ratio of one million. When density is thus included, the all-beta titanium alloy with a density of .175 lb./cu. in. gives a ratio of roughly 1,029,000 while a high strength steel (one that would produce a yield strength of 240,000 psi.) with a density of .278 to .280 lb./cu. in. offers a ratio of roughly 860,000.

The equivalent of an all-beta titanium casing with a yield strength of 180,000 psi. then becomes a steel casing with a yield strength of 280,000 psi. The development of steel casings with this strength is entirely feasible. But the work at Pratt & Whitney shows that by rigorously controlling the processing of the all-beta titanium alloy, it is possible to obtain a casing with a yield strength of 200,000 psi. and to

match this on a strength/density basis, a steel casing would have to have a yield strength of 320,000 psi.

Yield strengths of 320,000 psi. have yet to be obtained in production-line steel casings. On the other hand, Pratt & Whitney's 200,000 psi. figure for titanium has only been obtained so far with experimental rings. But the titanium advocates feel that the Pratt & Whitney data indicates it will be easier to obtain titanium casings with yield strengths of 200,000 psi. than steel casings with yield strength of 320,000 psi. Moreover, they say, considering the relative newness of the all-beta titanium alloy, it is very likely that it can be developed to produce casings with yield strengths substantially greater than 200,000 psi.

Translated into end results for a missile such as the Pershing, the use of titanium casings in place of steel casings to contain the same amount of propellant would save weight. This weight saving, which becomes more important in each succeeding stage, can be turned into added payload or range.

Another advantage of the all-beta titanium that becomes increasingly important in long-time storage is its superior corrosion and stress-corrosion resistance. The work at Pratt & Whitney has led project engineers to conclude that the all-beta titanium will outdo all materials considered for this job including the cold-worked and precipitation-hardened stainless steels.

Principal Process

Principal process used by Pratt & Whitney in the fabrication of titanium casings is flow turning. Carried out on Floturning machines made for Pratt & Whitney by Lodge and Shipley, the process is similar to roll forming (AW May 18, p. 119) and consists of cold-flowing metal over a mandrel by means of a spinning wheel. The starting structure is a roll-forged ring which is flowed out into a cylinder. Titanium end closures for the casing are domed forgings which are joined to the cylinder by girth welds. Igniter bosses are formed as an integral part of the case end closures. Three-dimensional machining, while expensive, is considered essential for the dome finishing.

As expected, welding of the all-beta titanium alloy proved to be difficult. With a great deal of experience in welding titanium, gained from its jet engine work with the metal and from some preliminary work on the all-beta alloy, Pratt & Whitney decided to use annealed or unhardened welds on its titanium rocket casings. Metal sections next to the weld area are beefed up 25-50% with the weld bead running about 20% thicker than the adjoining parent metal in order to compensate for the soft welds.

Army Shows Sergeant at Aberdeen Proving Ground

Army Sergeant artillery missile is equipped with vanes which extend and retract from the solid-propellant weapon's body to correct trajectory. Sergeant, not formally operational, is in the first stages of production; parts of the weapon system are still in the final stages of development. Jet Propulsion Laboratory is developing the 36-ft.-long missile for Army.

Northrop to Build GAM-87A Guidance

Washington—Guidance subsystem contract for Air Force's GAM-87A air-launched ballistic missile system has been awarded to Northrop Corp.'s Nortronics Division by the prime contractor, Douglas Aircraft Co.

This is the final subsystem contract to be let for the two-stage solid propellant missile. Aerojet-General will supply propulsion and General Electric will provide re-entry body design. Air Force system management is based at Wright-Patterson AFB, Dayton, Ohio.

The guidance system does not include the missile autopilot and probably will not require installation of additional navigation and guidance gear in the standard USAF bombers scheduled to carry the GAM-87A. This indicates that finer launch position data and vertical reference needed for the ballistic guidance problem must be derived within the missile. Nortronics specializes in stellar inertial guidance systems which can meet these requirements.

In recent months, the company has been seeking to diversify the applications of stellar inertial guidance equipment and techniques which have grown out of a program that began with the Mark I stellar inertial system used in the Northrop SM-62 Snark airbreathing missile system.

One trend in recent equipment has been to save weight and improve reliability by eliminating special analog-digital converters through design of star trackers and stable platforms with digital outputs. Most recent Nortronics stellar inertial system is the A-5 model intended for an airborne early warning and control aircraft that was never funded. GAM-87A will not need guidance as costly and complex as the A-5 which was to have been used for long duration flights. It probably will incorporate many of the A-5's features, however.

Out-of-Atmosphere Anti-Ballistic Missiles Studied by Chance Vought

Dallas—Anti-ballistic missiles with ranges out of the atmosphere and beyond are just one of the projects Chance Vought now counts in its "products package," Company President F. O. Detweiler revealed here last week.

In addition to mentioning Chance Vought's interest in this field for the first time, Detweiler revealed that the company will strengthen the basic and applied research programs supported by each of its five divisions by developing an entirely separate Chance Vought Research Center aimed at generating new knowledge.

Detweiler noted that the need for diversification required as a result of defense spending ceilings will carry Chance Vought into additional expansions outside the aircraft industry to supply commercial markets, although these plans are not yet ready for formal announcement. The company last year acquired its first subsidiary, Genesys Corp., Los Angeles, a computer systems firm.

High cost of today's defense systems —some of which are expected to cost up to $10 billion from concept through operational use—will ensure that there will not be too many such systems in the total procurement. He noted that cost of such a system would have provided for all the bombers, fighters and transports purchased just 10 years ago.

Program reductions resulting from purchase of today's costly weapon systems come at a time when the industry must invest larger amounts of its own money in research, test and production facilities. This reinvestment rate, he noted, is already greater than that of any other industry, accounting for approximately 60% of earnings. The aviation industry's net earnings last year, after taxes, averaged only 2% of sales.

As a further indication of the rising cost of weapons, Detweiler noted that during World War II cost of aircraft was approximately $10 per pound; during the Korean conflict this climbed to about $25; today's high-performance aircraft are costing $50 or more per pound, and for the next generation of very high performance planes, the cost per pound will probably be near $100.

Chance Vought expenditures for research and development in the first six months of this year represented an increase of more than 70% over the same period in 1958, Detweiler reported, and will result in expenditure of $8.5 million this year. The company's current backlog amounts to more than $300 million.

Although the company is well advanced in developing space flight and systems capabilities—its pilots and engineers have made more than 200 missions in the company's earth-orbital navigational flight simulator—Detweiler emphasized that manned aircraft still play a big role in the company's future.

The company believes that the F8U Crusader series carrier-based fighter will be responsible for providing it with more than $1 billion in contracts over the airplane's entire history. A $25 million contract last June for additional F8U-2N limited all-weather fighters is expected to be considerably increased by a larger follow-on order to be announced soon, he said.

ALBM Comes Close To Satellite Path

Washington—Martin air-launched ballistic missile test vehicle fired from a Boeing B-47 bomber near Cape Canaveral, Fla., last week came "fairly close" in its effort to cross the trajectory of the Explorer VI satellite as the vehicle neared its perigee about 160 mi. above the earth.

An Air Force spokesman said late last week that although the data obtained during the flight is still being evaluated, all indications pointed to a highly successful test after earlier attempts to conduct the experiment had failed (AW Oct. 5, p. 34).

Primary purpose of the experiment was to obtain data on the trajectory of an ALBM and to test the Martin-developed guidance system as well as demonstrate the feasibility of firing ballistic missiles from aircraft.

The test vehicle, left over from the USAF ALBM competition subsequently won by Douglas Aircraft Co., was fired from the B-47 by a three-man Martin crew, reaching its apogee at the relative perigee of the satellite.

The test vehicle was programed to fire five flares at intervals as an aid to ground-based cameras attempting to photograph it. One flare was observed at about 330 sec. after launch as the missile neared its apogee.

Air Force spokesman said the beacon on the second stage of the missile was tracked by the National Aeronautics and Space Administration's Wallops Island, Va., station from 80 sec. after launch until 600 sec. after launch.

The second stage fell into the ocean approximately 1,000 mi. off the coast of Nova Scotia. The Air Force declined to say just where the first stage fell. It followed a ballistic trajectory but did not attain sufficient speed to burn upon re-entry.

An earlier attempt to launch a Convair-developed ALBM test vehicle from a Convair B-58 toward the trajectory of the Discoverer V satellite failed because of telemetry problems. The Martin vehicle fired last week was scheduled to be fired earlier but was canceled two seconds before the scheduled firing because of technical difficulties.

Soviets' Third Lunar Probe to Orbit Earth

Moscow—Russia's third lunar vehicle, which "rounded" the moon last week, is expected to revolve around the earth Oct. 18 from north to south in an elongated ellipsis with an apogee of 292,043 mi., a perigee of 24,854 mi. and a period of 15.3 days.

Minimum velocity of about 0.24 mi. per second when it passed the apogee of its orbit increased to .31 mi. per sec. Oct. 12. It is to reach maximum velocity of 2.4 mi. per sec. when it comes closest to earth. The satellite is moving in a plane almost perpendicular to plane of the moon's orbit.

"Life expectancy of the space station is unlimited if one discounts such accidents as collisions with meteorites," one Soviet scientist said. The scientist, Dr. Ari Shternfeld, said the station will pass in the vicinity of the moon from time to time, coming closest in January, 1967, at 6,000 mi.

Explorer VII Satellite Launched by NASA

Washington—National Aeronautics and Space Administration's composite radiation satellite vehicle was placed into orbit last week in the last of a series of space experiments originally planned by the U. S. as a part of the International Geophysical Year.

The satellite, designated Explorer VII after its successful launch from the Air Force Missile Test Center, Cape Canaveral, Fla., is designed primarily to study the direct radiation from the sun and the fraction of this radiation which is converted into heat by the earth and ultimately re-radiated back into space. Details of the seven experiments carried in the payload were reported by AVIATION WEEK last Aug. 3 (p. 61) after an earlier attempt to put the satellite into orbit failed when its Juno II carrier malfunctioned immediately after launch.

By late last week, all instruments aboard the Explorer VII appeared to be functioning, although signals from one of the two radio transmitters aboard

CANNON PLUGS

A new design in Cannon Plugs. The new ALRF line consists of aluminum versions of the standard N, SC, LT and BNC plugs designed for installation where weight-saving is a critical design criteria. To provide further flexibility for the ALRF line Cannon has available a new series of ALA cable adapters for use with semi-rigid aluminum RF cables. The new Cannon ALRF plugs offer 35% lighter material weight plus many important improvements in design characteristics, including: • **Superior Electrical Performance** achieved by a new internal design in which the braid is crimped to the collett providing optimum bond. • **Improved Moisture Sealing Characteristics** due to an improved design of the silicone rubber grommet, providing a tighter bond with the cable jacket. • **Improved Clamping Mechanism** for more positive gripping action without distortion of the outer braid. • **Improved Resistance to Corrosion** through a black anodized finish giving superior resistance to corrosive elements. In the ALSC series a reversal of pins and sockets can be specified. All of these design advantages are available in the new Aluminum RF Line from Cannon Electric Company—3208 Humboldt Street, Los Angeles 31, Calif. Write for Cannon Catalog ALRF-1—Please refer to Department 110. Factories In Los Angeles, Santa Ana, Salem, Toronto, London, Paris, Melbourne and Tokyo. Distributors and Representatives in the principal cities of the world.

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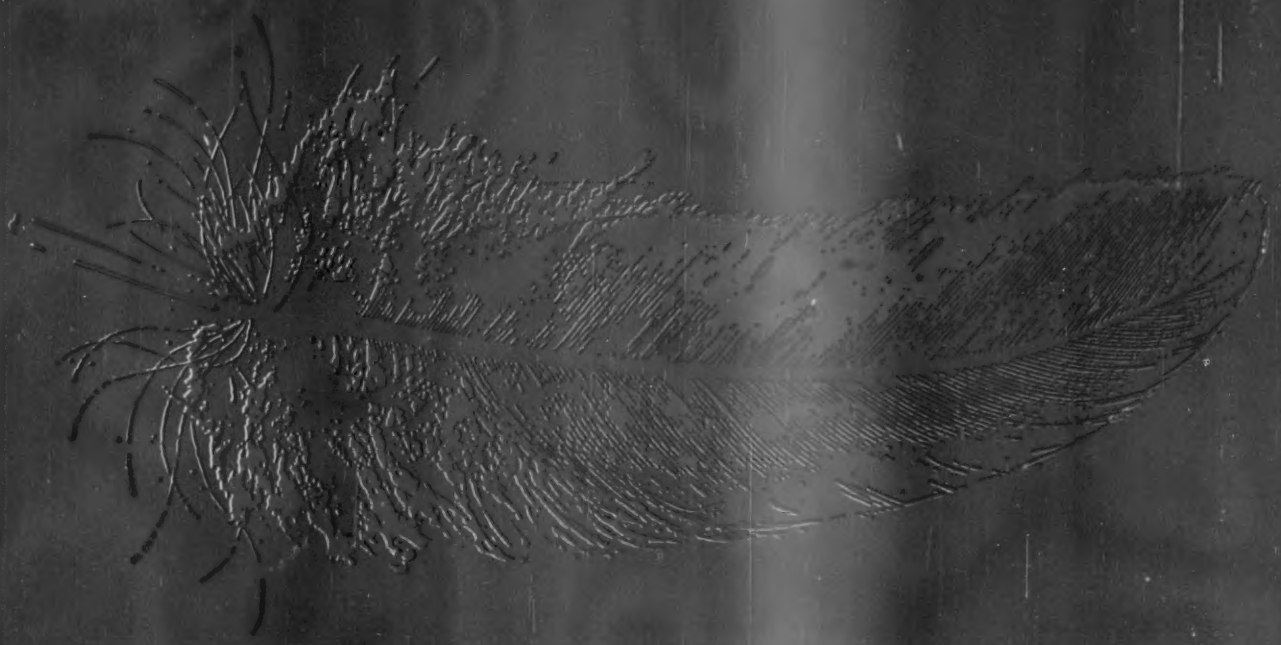

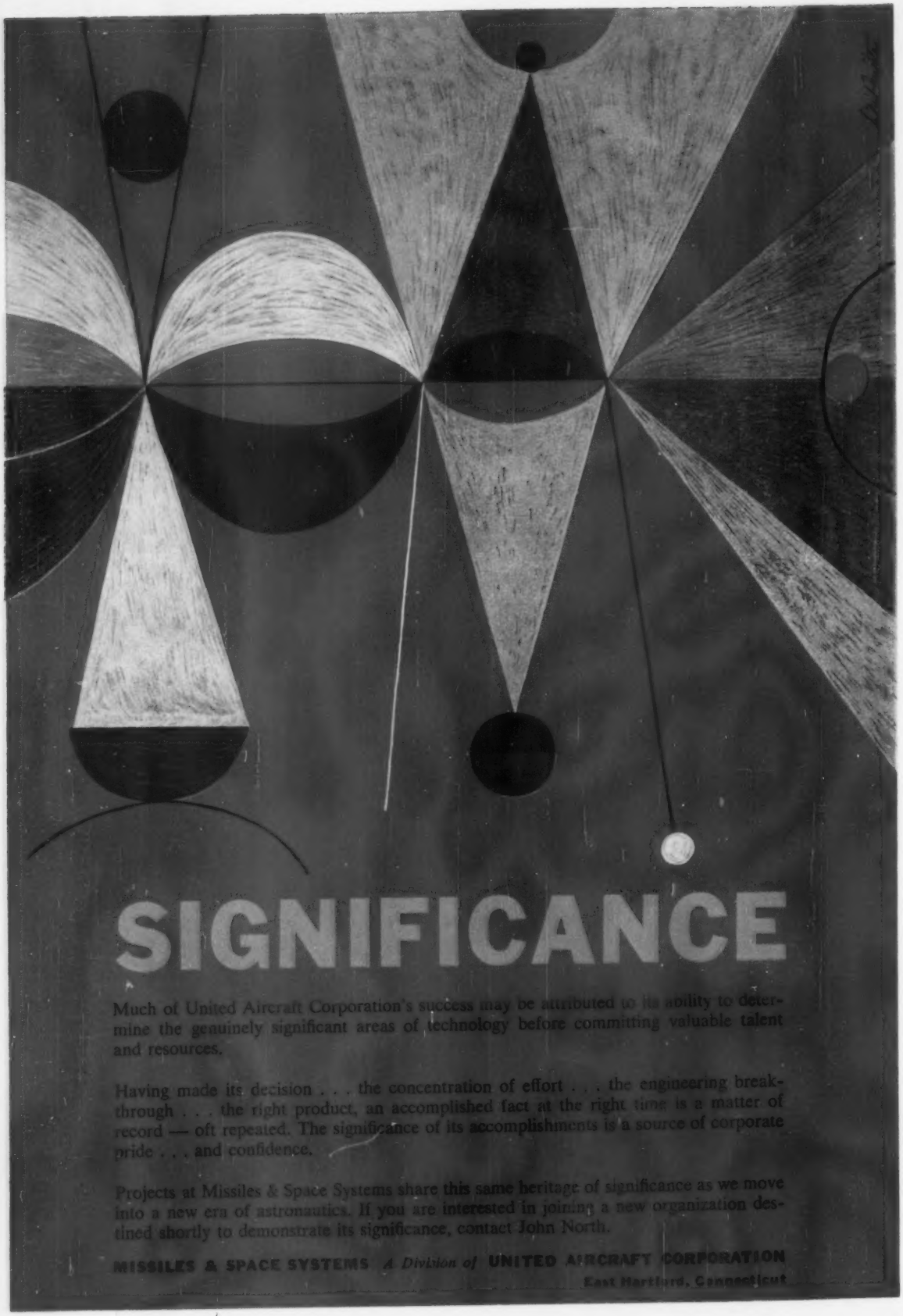
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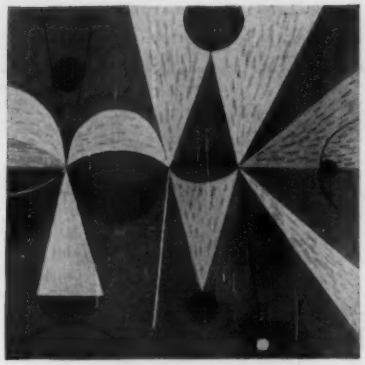

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Reply to Mr. John North

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were slightly weak, it was reported.

The transmitter, which operates at 108 mc. and is powered by solar batteries, was designed to serve as a beacon for ground tracking stations as well as telemeter back measurements made by a micrometeorite experiment, and, despite their weakness, the signals were being received by all tracking stations.

Signals from the primary 20 mc. telemetry transmitter powered by two chemical batteries are strong and clear, NASA said. Transmission from the solar transmitter will be cut off by an automatic timing device in the satellite at the end of one year.

NASA set the period of orbit at 101.3 min.; the perigee at 316.6 stat. mi.; apogee at 701.9 stat. mi. Perigee velocity is 17,380 mph.; apogee velocity, 15,945 mph. The 91.5 lb. satellite was placed in orbit at an angle of 50 deg. to the plane of the equator.

The launching vehicle, designed by ABMA, was a conventional Juno II booster except for a support cylinder.

Data being obtained from experiments and radioed back to ground stations will be processed in six weeks to two months and sent to experimenters for evaluation and analysis.

British Establish Minister of Aviation

London—All aspects of British Aviation—both civil and military—will come under one ministry in the post-election reorganization of the British cabinet, which does away with the old Ministry of Supply. The reshuffle concentrates responsibility for promoting scientific development under one cabinet member, the Lord Privy Seal.

New Minister of Aviation is Duncan Sandys, who yields his post as defense minister to Harold Watkinson, former Minister of Transport, Civil Aviation.

Sandys takes over civil aviation responsibilities formerly in the Transport Ministry, and all matters related to research, development and production of civil and military aircraft, guided and atomic weapons, radar and electronics, all of which were previously administered by the Ministry of Supply.

No new science ministry has been formed to promote British scientific effort in the civilian field as was generally predicted before the election. Instead, the duties of the Lord Privy Seal have been extended to embrace space research and all matters related to atomic energy in particular and the promotion of scientific and technological development in general.

Lord Hailsham, who has been holding the office of Lord President of the Council (and chairmanship of the Conservative Party), has been appointed the new Lord Privy Seal.

News Digest

Britain and the U. S. have agreed to exchange personnel to obtain better coordination between the two countries in their development of air navigation aids and aviation facilities. Agreement was an outgrowth of a conference of high-level British and U. S. aviation officials, which was concluded last week in Washington. The United Kingdom delegation was brief on Federal Aviation Agency research and development program and visited National Aviation Facilities Experimental Center in Atlantic City, N. J.

Northrop and General Electric engineering team will begin testing in December of advanced thrust-augmentation system to be applied to J85 turbojets to provide speed in excess of Mach 2 in the first production-line N-156F fighter airplanes. Pre-compressor cooling system for the N-156F uses water to cool air entering the engine as opposed to water injection used on jet transports.

Bell Aircraft Corp. has turned its X-14 VTOL aircraft over to NASA for further flight tests at Ames Research Center, Moffett Field, Calif.

Trans-Australia Airlines intends to order about $56 million worth of British jet airliners by 1961, according to Warren MacDonald, National Airlines Commission chairman currently in London. Choice will be between Vickers VC-10 and de Havilland DH-121, as they appear to be the only suitable jet aircraft available for the 1963-66 delivery date, MacDonald said.

Nike Zeus Future

Washington—Experimental Nike Zeus anti-ICBM missile was fired last week from White Sands Missile Test Range as part of series of tests scheduled to extend through next Spring which may determine the future of the Army program. Army termed the test successful, despite a malfunction during the coasting phase which caused it to fall short of trajectory.

Complete technical appraisal of the Zeus program now is under way in Defense Department. Current estimate is that $13.5 billion will be required to implement Nike Zeus missile installations to protect major urban centers and military installations. The Fiscal 1961 budget is not expected to seek additional funds for Zeus program beyond the $135 million authorized in 1960 budget. However, if President Eisenhower decides to fully implement the program, Defense Department will ask Congress to provide funds in a supplemental appropriation.

BOAC Stand May Spark Price-Cut War

Carrier's determination to set its own standards will leave IATA members without basic structure.

By L. L. Doty

Tokyo—British Overseas Airways Corp., in an uncompromising drive to fix its own rate standards, has scuttled the International Air Transport Assn. traffic conference in Honolulu and set the stage for an open rate situation that could deteriorate into a price-cut war on international airline routes next year.

The strong stand taken by the British carrier, reportedly with the determined backing of British manufacturers and the Minister of Transport, leaves some 80 IATA members without any basic fare structure on all international routes, including the transatlantic and transpacific, except those in the Middle East and Europe and between North and South America.

The Honolulu traffic conference (AW Oct. 12. p. 40) bogged down when it became evident that British delegates were unwilling to negotiate any of the give-and-take issues at stake. Last year, the traffic conference broke up in a deadlock at Cannes over the jet surcharge issue but a solution reached at the reconvened conference in Paris in February saved the carriers from an open rate situation.

This year, however, a majority of the large airlines took a strong stand against any resumption of the talks when the British showed no signs of relenting on major points. And, at the general meeting of IATA here, the association's executive committee announced late last week that it would not authorize a reopening of the traffic conference. Rates now in effect expire on Mar. 31, and fares after Apr. 1 will definitely be open rate.

Controversial Points

Here are three main controversial points which have caused the stalemate:

• **Seating configuration.** BOAC wants to include sleeperette-type seats on jet aircraft without extra charge. Other carriers want standard pitch for first-class seats on jet aircraft but are willing to concede deep reclining or sleeperette seats without surcharge for operators of piston-engine aircraft on long-haul routes. BOAC has locked horns with Air India International on the installation of berths which Air India wants but BOAC opposes.

• **Tourist class.** BOAC wants to retain three classes of service—first class, tourist and the economy plan. Most of the international carriers, viewing the rapid decline in the demand for tourist service over transatlantic routes, want to see tourist class service dropped.

• **Fare level.** BOAC wants to expand the economy fare throughout all international routes. Other carriers strongly support lower fares but insist that some areas cannot absorb lower fares without violently upsetting revenue-cost ratios to produce deficits on low-density routes. Most observers here feel that the British stand on these points is keyed to the load capacity and operating characteristics of aircraft manufactured and operated by the British. British European Airways ran into no major difficulty in reaching agreement with other carriers on the fare level for European routes.

Most carriers now feel that tourist-class services have been made obsolete by economy-plan type service. The British presumably want to see a continuance of tourist service on many international routes because of the large number of civil servants who will use tourist class in preference to the economy plan but who cannot afford first-class type service.

On the fare issue, a majority of the airlines want to see an end to jet surcharges or fare differentials and allow piston-engine operators to provide additional services plus more commodious seating configurations than are offered by jets at no additional cost to passengers as a means of maintaining a competitive character between the two types of aircraft.

The deadlock over the three main issues poses a serious threat to the IATA traffic conference mechanism. Delegates here view the clash between the British and other members of IATA as a far more serious breakdown in inter-airline relations than last year's struggle at Cannes over the jet surcharge issue.

Showdown Sought

Late last week, most carriers were willing to take this risk as the only means of bringing on a showdown with BOAC. As the general meeting drew to a close last week, the British bloc consisting of BOAC and five Commonwealth carriers gave no indication of relenting in its determination to push the expansion of lower rates without changing configuration to match those rates on a world-wide basis.

During the closing hours of the traffic conference, when late night sessions were held in moves to reach some compromise that would remove the threat of an open-rate crisis, it became apparent that further negotiations with the British would be hopeless.

Specifically, BOAC stood firm throughout the conference for an economy plan rate on Europe-to-Africa routes and routes to the Far East that would be 20% below the standard tourist fares now in effect in these route regions. The carrier also wants to retain both de luxe and tourist configurations for all aircraft operating over these routes.

South African Airways told the conference that it could not face the public criticism that would result in its area if it failed to return without authority to lower fares. East Africa and Central Africa airlines were equally firm.

It became increasingly evident to delegates during the course of the conference that BOAC and the Commonwealth carriers were acting under a virtual mandate from the British government to bring about a revised rate structure.

IATA to Copenhagen

Tokyo—International Air Transport Assn.'s general meeting will take place in Copenhagen next year, to be followed by Sydney, Australia, in 1961 and Dublin the next year.

President of IATA this year is Seijiro Yanagita, head of Japan Air Lines, which was host company of the 15th annual general meeting here.

Nobuske Kishi, prime minister of Japan, Shuji Masutani, deputy prime minister, Wataru Narahashi, minister of transportation, and Ryitaro Azuma, governor of Tokyo, addressed the opening session of the general meeting. Prince Takamatsu was present at the meeting.

First CL-44 Rolls Out

First CL-44, a side-loading airfreighter, is rolled out at Canadair, Ltd.'s, Montreal plant. Twelve of the side-loading versions have been ordered by RCAF; Flying Tiger Line and Seaboard & Western have ordered swing-tail models. First flight is slated for November.

W. G. Wood, of Trans-Canada Air Lines, conference chairman who was unanimously lauded for the manner in which he maintained control over the bitter conference in-fighting, warned the delegates on several occasions that the conference was threatened with a "serious crisis." He admitted that much had been achieved in the early stages of the conference but added that it was a "terrible pity" that member airlines were faced with a deadlock in the closing hours that could "wreck" IATA.

Wood told delegates that the choice of a compromise lay with the members themselves and urged that a strong attempt be made to reach a solution of the differences existing between the two warring factions. BOAC delegates referred to the chairman's statements as very serious remarks and reiterated their determination to introduce their proposed rates on African and Far Eastern routes.

There was strong indication at the general meeting that the British were prepared to take unilateral action and introduce the fare plan on Apr. 1, regardless of the opposition of other IATA carriers.

Most carriers opposing the British position charged that the African market is extremely limited because of the low economic level prevailing in most African countries. One member said privately that lower rates would not attract any more travelers than those now using the airlines since "we are catering to a market that is still without sufficient food."

BOAC delegates admitted that there may be some areas which are not yet due for the economy-plan rates it proposed but added that there are many territories, particularly East Africa, which are prosperous and provide attractive vacation sites. The British urged IATA to take no steps that would put a "fence" around these territories, thus causing them embarrassment.

In obvious response to British demands for lower rates on Far Eastern routes, J. R. D. Tata, chairman of Air India and retiring president of IATA, had this to say at the opening plenary session of the general meeting:

"During the same period (that transatlantic fares were being lowered), minimum IATA fares between London-Bombay and Bombay-Tokyo, which were always substantially lower than European and Atlantic fares, have remained about the same or edged slightly downwards."

He later told AVIATION WEEK that fares on these routes were now in line with other fares and that a 20% reduction would be disastrous to unsubsidized operators.

On this point, he told the IATA general meeting that "while there are no doubt within IATA some high-cost airlines subsidized by their governments, others are recognized as being as lean and aggressively efficient as any transport operator in the world, and even they have only managed to make pretty thin profits up to now."

During the traffic conference in Honolulu, KLM Royal Dutch Airlines, in one almost-successful compromise move, suggested that all current fares be revalidated for another year on the grounds that the BOAC proposal may be too early. KLM delegates said they were offering the compromise move in an attempt to stave off another conference adjournment without agreement as happened at Cannes. The KLM move was seconded by Sabena.

Pan American agreed to the motion but added that all fare structures must continue to be related to seating capacity. Although a strong proponent of low fares, Pan American made no overt move to side with the BOAC stand, and later at the general meeting led the opposition with SAS to the BOAC proposals. Pan American made a strong bid for a promotional type fare, particularly in the North Atlantic region. Discussions on such fares, including a final decision on jet surcharges, were sidetracked by the deadlock on other issues.

Air France echoed the warnings of other carriers against adjourning in "defeat." The French delegates said the governments may step in to administer rates and tariffs through "civil servants who may not be conversant with airline business." They added that troubles "carriers now face will be nothing to those they might face if this eventually becomes a fact."

Most delegates viewed the BOAC proposal as a losing proposition at the outset. One group estimated that costs of operation on the Far East and African routes would call for a "124% load factor or standing room only" as a breakeven point.

The British bloc, however, was insistent that lower fares would develop new markets, thus creating higher load factors, and that seat costs would be substantially reduced by introduction of the 34-in.-pitch seats of the economy plan on a wide scale. Alternatives such as gradual introduction of promotional or developmental type fares were largely rebuffed by the British.

Chief reason the traffic conference was bogged down by the British position is that close interrelations of other fares on other routes to the fare structure on Far East and African routes prevents the individual handling of regional fare problems. This means that the expansion of economy rates in the Pacific area may be delayed officially beyond Apr. 1, the target date Pan American had set for the introduction of lower fares in that area unless the airline takes advantage of the open rate situation.

DOUGLAS DC-7F cargo conversion's passenger windows are permanently sealed by dural plugs. Cargo door replaces passenger door.

DC-7F Service Marks Cargo Race Start

By Glenn Garrison

New York—Introduction this month of the first Douglas DC-7 aircraft converted into all-cargo service marks the beginning of a new air freight push by several carriers, sparked by the availability of equipment as late-model piston planes are replaced by jets on the blue ribbon passenger runs.

American Airlines has received the first units of its airfreighter DC-7Fs in a total order of 10 which Douglas is converting from DC-7Bs at a cost of $4.25 million. Pan American World Airways expects to get the first of 10 DC-7 cargo conversions in December under a contract with Lockheed Air Service, Ontario, Calif. United Air Lines has ordered six of the Douglas conversions and plans to begin putting them in service next spring.

Transcontinental and international all-cargo service by Trans World Airlines is being greatly expanded with the allocation of six Lockheed Super H Constellations to cargo runs. These aircraft were shifted from Military Air Transport Service work, where they recently completed a one-year contract involving the transatlantic movement of 121,000 military personnel and dependents and 4,200 tons of cargo.

Two converted Lockheed 049 Constellations also have been added to TWA's all-cargo fleet. "Up to now, we have done a good job of cargo service on passenger airplanes, but our lift of all-cargo aircraft has been limited," TWA President Charles S. Thomas said recently. "These (additional airplanes) will increase our present cargo lift by more than four times on international service and by nearly eight times on domestic."

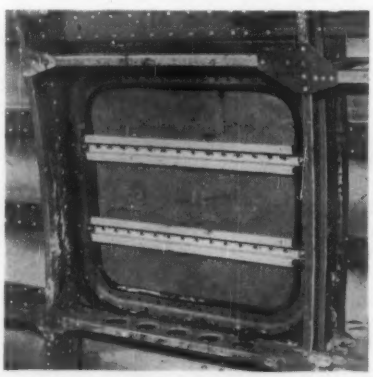
American chose the DC-7F to supplement its present 10 DC-6A all-cargo aircraft as the plane best suited to fulfill "the immediate need of additional cargo lift" caused by the "rapid growth of the air cargo business." The DC-7F, according to American, was quickly available whereas "there was no advanced airfreighter on the market that would be available as quickly as the converted airplane."

Depreciation Factor

Besides availability, another obvious advantage of using the phased-out piston planes is the fact that they are well along toward being written off in depreciation.

American's DC-7Fs carry 33,500 lb. of payload vs. 30,000 for the DC-6A and 43,000 lb. for the Super H Constellation. The DC-6A cannot provide transcontinental service at maximum payload without a fuel stop, whereas the DC-7F and Super H can.

The combination carriers presently face transcontinental all-cargo competition only from Flying Tiger Line, presently operating a fleet of Super Hs on its cross-country common carriage routes. Flying Tiger has placed a firm order for 10 Canadair CL-44D turboprop freighters and expects to get the first in the spring of 1961. On the basis of expected sharply reduced operating costs with these airplanes, Flying Tiger Line has announced plans to file a new tariff next year which will bring air freight rates down to a 13 to 14 cent per ton mile average. Current figure is about 18 cents. This new tariff, with rates ranging from a low of about 6 cents per ton mile, is expected to include specific commodity rates under an entirely revised structure.



WINDOW PLUG has two longitudinal stiffeners and is pressurized.

Flying Tiger's tariff proposal also will be based, according to President Robert W. Prescott, on an extensive research program instituted this year by the airline. First phase, scheduled to end this year, covers an analysis of the carrier's own records for the past 10 years, including breakdowns by commodity, route segment and seasonal fluctuations. Also in the first phase is a sampling survey of Flying Tiger shippers at various points, in which 3,000 shippers have been interviewed.

The new tariff, aimed at "maximizing profits," will be filed early next year and should become effective about 18 months later, or at the time the CL-44s become operative, Prescott said. During the interim he expects a long battle from other carriers which, with their "obsolete equipment," he expects to oppose drastic rate reductions.

Financing of Flying Tigers' $51 million CL-44 order has been completed, according to Prescott, with 80% of the purchase price guaranteed by the Canadian government. Another measure was issuance of $5 million of convertible debentures, of which $3 million went to General Dynamics Corp. and $2 million to private sources.

Flying Tiger projects its CL-44 direct

operating cost at $.0457 per revenue ton mile for Fiscal 1962. This assumes 100% load factor at the aircraft maximum 66,000 lb. payload, 1,300 mi. route segment, average speed 350 mph., and average daily utilization of 11 hr.

By way of comparison, those units of the airline's Super Constellation fleet which were in common carriage of freight, as opposed to military contract work, operated at a direct cost of $.1023 per revenue ton mile for the 11 months ending May 31, 1959.

In the fiscal year ending June, 1960, the airline predicts it will carry 80.4 million revenue ton miles of air freight, using six Super Hs and one C-46. The Constellations will attain a load factor of 76% and will be utilized 9.1 hr. daily at a wheel-to-wheel average speed of 258 mph., according to the forecast. In the fiscal year ending June 30, 1961, seven Constellations and one C-46 will carry 93.2 million ton miles; in the following fiscal period, three Constellations and four CL-44s will carry 159.7 ton miles and during the final fiscal year covered, ending in June, 1964, an all-turboprop scheduled fleet of eight CL-44s will carry 271.7 million revenue ton miles of air freight at a load factor of 71%, according to the forecast.

As to the disposition of the Super H fleet after the turboprops have taken over, Prescott pointed out that the aircraft will be written down and any losses would not be "insurmountable" even if "we have to tie them to a fence post."

By mid-1961, he said, the Super Hs will be written to about $1½ million of their original $2.5 million cost.

Flying Tiger's operating costs for the projected air freight operations assume that the ratio of indirect to direct costs will remain at 55%. The CL-44's swing tail, along with pre-palletized, mechanical loading, will permit loading or unloading in 25 or 30 min, according to Prescott. This compares with four to five hours on the Super Hs, he said. Another expected saving, through greater utilization, is in the Rolls-Royce Dart turboprop engines which will power the CL-44. Prescott said his airline's present rate of en route engine failures is one in 1,200 engine hours, whereas Dart engines on Vickers Viscounts now have a failure rate of one in 100,000 engine hours.

The ratio of indirect to direct costs of future cargo operation assumed by Flying Tiger is challenged by one of its big combination competitors, American Airlines. David Highman, American's director of air freight sales, believes direct operating costs may go down to 30-40% of indirect costs as aircraft become more economical and ground handling systems more complex and expensive.

"But you don't really know at this point," Highman adds, although in his view there is bound to be a difference from today's ratio. With the DC-7F, direct costs may be 45-55%, Highman estimates.

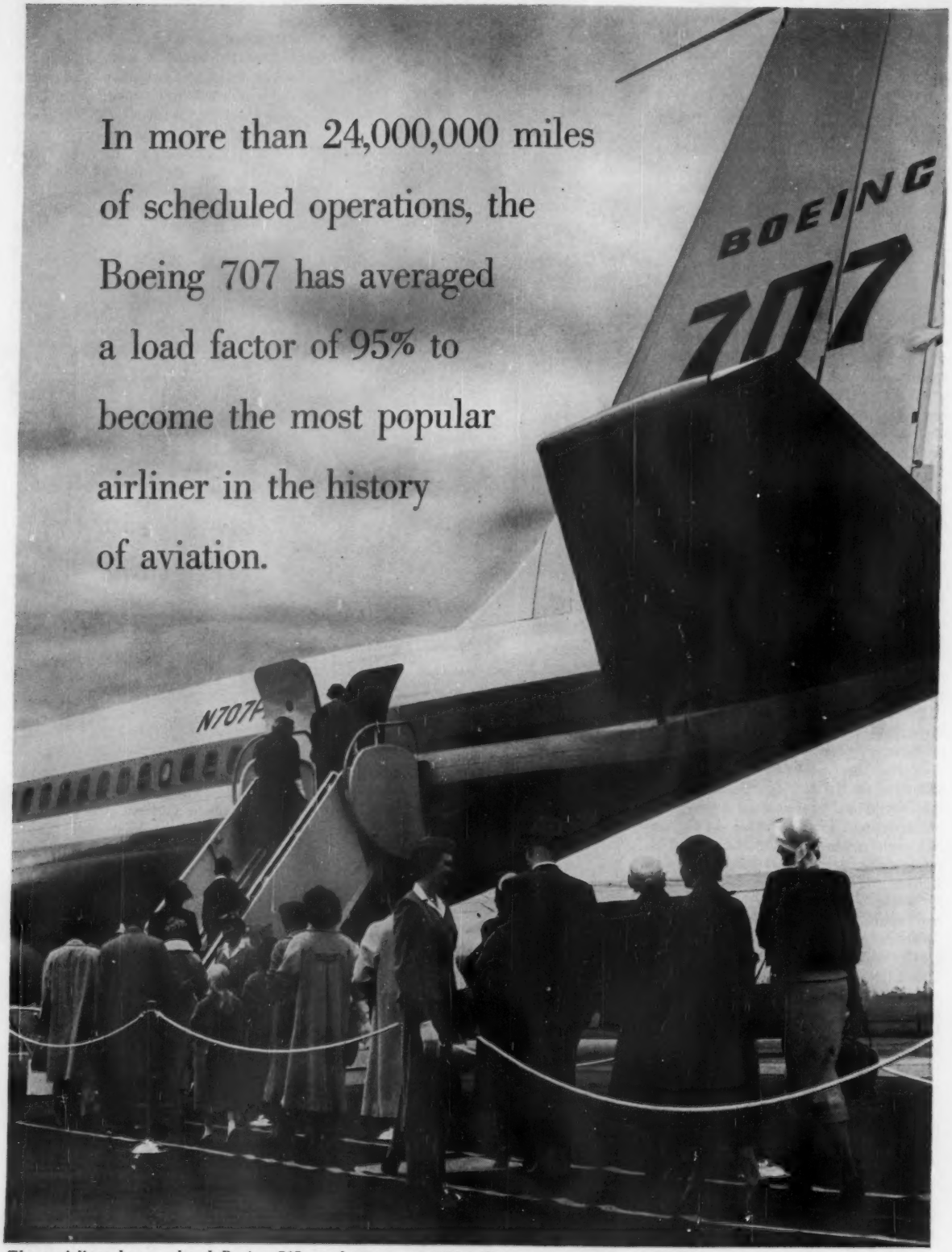
Proposals Analyzed

Regarding Flying Tigers' estimates of CL-44 costs, Highman said American has analyzed all cargo aircraft proposals and the airline can't "in our wildest imagination" see how the costs could be as low as Prescott predicts. Regarding Flying Tiger's plans to file the new tariff, the American official said there would be no objection from his airline to a proposal to end the minimum rate order, which he said a 6 cent rate would in effect do.

Highman doesn't believe an immediate price reduction is necessary to expand air freight and derides "the magic plane which will give a magic price too" as the panacea for all air freight development problems. He more strongly stresses the "sales engineering" approach to cargo development, which involves selling air transportation as part of an industry's entire distribution system rather than only a quick means of moving goods.

Prescott espouses this philosophy too,

LARGE aft cargo door (above) swings upward; smaller side-opening door is for personnel entry. Crash net at cockpit bulkhead (below) is made of plastic sheathed steel cable.



These airlines have ordered Boeing 707 or shorter-range 720 jetliners: AIR FRANCE • AIR-INDIA • AMERICAN • B.O.A.C. • BRANIFF CONTINENTAL • CUBANA • IRISH • LUFTHANSA • PAN AMERICAN • QANTAS • SABENA • SOUTH AFRICAN • TWA • UNITED • VARIG • *Also* MATS

BOEING family of jetliners

but has said that the price factor is far more important.

American admits that it will need something more than a converted piston airplane to compete against the CL-44. But it wants a turbine-powered cargo plane with a mechanized loading system designed as an integral part of the aircraft and doesn't want to design and apply such a system after buying the plane. Highman said American might have bought the CL-44 if such a unit had been included.

American is looking for a jet or turboprop freighter with direct flight costs of 4 cents per available ton mile. Turbofan possibility has been particularly attractive to the airline. It is projecting future operations on the use of two new turbine airplanes, one with a 45-ton payload and the other with a 25-ton payload. These assumptions were made in exhibits in a current air cargo case before the Civil Aeronautics Board in which a fleet of five DC-7Fs and 10 DC-6As is projected for the end of 1959. At the beginning of 1961, the fleet would include 10 DC-7Fs and 10 DC-6As; by 1965, five 45-ton turbine aircraft and 10 turbines with 25-ton payload would comprise the all-cargo fleet. The turbine aircraft are assumed to operate at the 4 cents per available ton mile direct cost and to permit establishment of a 15 cents ton mile rate in 1963.

The projections, American advised CAB, are based on the airline's obtaining authority to operate its all-cargo aircraft "with complete flexibility as far as route restrictions are concerned."

In computing its projections, American used a seven-year service life and 15% residual value in depreciating its DC-6As, and a five-year, 15% residual basis for DC-7F depreciation.

Direct flight costs of the DC-6As were projected at $7,213,000 for 1960, $7,589,000 for 1961, $6,900,000 for 1962, and $5,760,000 for 1963.

For the DC-7F, costs were $5,984,000 for 1960; $8,671,000 for 1961; $10,632,000 for 1962; $9,349,000 for 1963; and $7,191,000 for 1964. For the jet freighters, costs were $4 million for 1963 and $12 million for 1964.

Average daily utilization in 1964 was projected at 5:50 hr. for the DC-7F, 7:05 for Jet A, and 7:12 for Jet B.

As far as traffic is concerned, American predicts it will fly 259,850,000 revenue ton miles of freight, express and mail in its all-cargo aircraft in 1964. Forecast load factor is 70%.

Douglas sees development of a market able to support jet cargo carriers and solution of the problem of what to do with retired first-line passenger aircraft as potential benefits of cargo conversions of the DC-7 series.

Main part of the DC-7 conversion, which costs $485,950, is installation of a strong cargo floor nearly identical to that in Douglas DC-6A, Air Force C-118 and Navy R6D. If the customer is already operating the DC-6A, Douglas will make his DC-7 conversion as similar to his DC-6A as possible to hold down the cost of engineering and facilitate maintenance.

The DC-7 cargo floor is 40 in. longer than that of the DC-6A but structural design and load limits are the same and DC-6A cargo doors are used.

It takes about five months to convert a DC-7 to cargo. The passenger interiors are removed and the passenger floor, stressed for 29 lb. per running inch, is replaced by a cargo floor stressed for loads of 84 lb. per running inch. Both floors strengthen the fuselage shell about equally, taking some loads in tension. Heavier structure can be inserted in some places to make possible later conversion to turboprop power.

Doors and door frames are identical to those used in the DC-6A. The door limits the pressurization differential to 4.16 psi. or 75% of the 5.45 pressurization differential in the passenger version. Extra structural strength for pressurization to passenger requirements is retained as a bonus in the cargo version. In some places structure was made heavy for sound damping purposes and this, too, will be kept as additional strength in the cargo airplane.

Floor is light and strong, made of .032 dural sheet and corrugated stiffeners. Dural does not have a tough enough surface to survive the punishment of cargo operations. For this reason, it is protected by an easily replaceable plywood pad. Some cargo plane manufacturers believe a cargo floor should be constructed of strong, tough-surfaced magnesium plank which can be used without a protective surface. Douglas engineers argue that any cargo floor will probably have to be replaced eventually and that the difficulty of replacing a permanent floor is too great to be acceptable. Hard steel tie-down cups in the Douglas floor can take tool and pry bar loads without being gouged.

Tie-down rings are spaced on a 20-in. grid pattern. Each will withstand a 2,400 lb. crash load. Two steel cable crash nets are provided. One at the cockpit aft bulkhead will withstand 31,000 lb. at 6g and the other which can be installed at a row of rings around the fuselage at mid-cabin which will accept a 10,000 lb. load. Cargo floor rests upon a substructure of four longitudinal C-section beams with 6-in. webs. Floor is stressed for distributed load of 200 psf. Transversal bulkheads are installed under the floor at 80- to 100-in. intervals. A sheet of dural is laid under the two center beams to make the enclosed space serve as the main air distribution duct for the cabin.

American Denies Influence Charge

Washington—American Airlines has formally denied competitors' charges that it attempted to influence a Civil Aeronautics Board decision granting the carrier nonstop operating rights between New York and San Francisco and has asked the Board to reject a rehearing request filed by Trans World, United and Northwest Airlines (AW Sept. 28, p. 48).

Replying to charges that the airline sought to "pressure" Board members by means of letters from senators and congressmen, and state and municipal officials, American said 80% of the communications questioned were filed with CAB prior to a hearing in the route case and that all were available for public inspection in the Board's docket section. Airline attorneys said that none of the letters were written by American and that of the 66 filed after the start of the nonstop case, half were addressed to the Board, the remainder communications from the CAB and that "virtually all" were written by congressmen.

Many of the communications, the attorneys said, dealt solely with ordinary procedural matters, such as the setting of procedural dates and site of the hearings, while others were routine transmittals from congressmen asking for CAB aid in answering letters.

The few congressional letters which did express personal opinions on future outcome of the case, the carrier said, were a matter of public record and covered by CAB's own rules.

American also contended that attorneys for Trans World and United raised no objections during oral argument to the Board's announcement that the letters would be included in the public record, nor, they said, did the lawyers seek to inspect the documents.

Further objections raised by the two airlines that former CAB member Louis J. Hector had no right to vote on the disposition of the case because he was absent during the argument also was contested by American. The airline said that past court decisions have held that CAB may vote with a quorum of three members who may have heard arguments either by being present or by a reading of records and transcripts.

American said that neither United nor Trans World counsel had objected to Hector's participation in the case, although both had been aware of his absence at the oral argument.

WESTERN
WESTERN

CAB Studies Ways to Expand Mail Plan

By Ford Eastman

Washington—Major expansion of the now limited Post Office program to move first-class mail by air may get under way within the near future.

Civil Aeronautics Board—required by law to establish a rate through procedures that are normally long and drawn out, involving public hearings and arguments—probably will adopt a short cut that could permit the Post Office to begin moving additional mail by air immediately.

Rather than first scheduling the case for hearings, the Board can propose what it believes to be a "fair and equitable" rate after informal meetings with Post Office and airline officials and, at the same time, issue a show cause order. If exceptions to the rate are filed by either the Post Office or airlines, a temporary rate would be established under which the mail could be moved while the CAB proceeded with hearings. A permanent rate would be fixed at the conclusion.

Meetings Being Held

Meetings between the CAB and Post Office Department are now being held to establish procedures under which the expanded movement of first class mail by air can begin.

At present, the airlines are participating in an experimental program begun in 1953 in which regular first-class mail is transported by air between a limited number of points. Since the mail was to be carried on a space available basis, the rates set averaged between 18 and 19 cents a ton mile for trunklines as compared with a domestic average of about 40 cents a ton mile for airmail. For local service lines, the rates averaged 30 cents a ton mile as compared with an average yield of about 99 cents a ton mile for airmail. About 25,000 tons of first-class mail are moved annually under the program.

CAB estimates that in Fiscal 1959 a total of 18,096,000 ton miles of non-priority first-class mail were carried by air at an estimated dollar payment to the carriers of $3,296,000, including $107,000 for local carriers.

If the volume was increased from 25,000 tons to 175,000 tons as planned in the future, the dollar volume to the airlines would increase to $23,072,000, including $749,000 to local service carriers, assuming that the rates were about the same as those set for the experimental plan.

Under the Post Office Department's proposed program, air transportation would be used in these operations:

• **Between major population centers** where, although distances may not be great, surface transportation is such that overnight delivery is not practicable. This would include service between Chicago and Minneapolis, Atlanta and Tampa, Pittsburgh and Detroit, St. Louis and Kansas City, Washington and Boston, Cincinnati and Nashville.

• **Between overseas points** such as Alaska, Hawaii and the Commonwealth of Puerto Rico where water transportation is too slow for the standard of service required to maintain a proper community of interest. An estimated 560 tons of first-class mail would be moved annually to these points.

• **Between points served by** local-service carriers where surface transportation and other factors are such that the postal service would be improved. Initial estimates show that about 23,000 tons of first-class mail would be involved each year.

• **Between points where service** would not only be improved but where a more efficient and economical operation for first-class mail can be obtained. This would involve an extension of the existing airlift from New York, Washington and Chicago to such points as Denver and Dallas and to the West Coast cities of Los Angeles, San Francisco and Seattle in both east and west movements. The extension would involve an estimated 29,200 tons of mail annually, some of which now moves by highway as well as by rail.

Greater use of airlines to move the mail is needed, Post Office spokesmen say, since in recent years "thousands of mail-carrying passenger trains have been discontinued and service to thousands of communities has been eliminated entirely." The Department adds that there is no indication that the trend will be reversed. An added factor is that, while the rail volume declines, the volume of mail is expanding at a rapid rate.

In recent hearings before the Senate Committee on Post Office and Civil Service, Post Office Department witnesses testified that, in addition to the 25,000 tons of mail now airlifted under the experimental plan, there are another 150,000 tons of first-class mail in terms of 1958 volume moving over distances of more than 300 mi. by surface transportation. This, if the new program is adopted, would eventually be moved by air.

Initially, however, only a portion of the 150,000 tons would be moved by air—about 53,000 tons within six to eight months after the program began. Third and fourth-class mail, representing the bulk of all mail, would continue to move by surface transportation in the immediate future, the witnesses said. Total mail moving more than 300 mi. amounts to about 2,614,538 tons.

The stage was set for an expansion of the program when the Post Office Department asked the last session of Congress to clarify the authority of the Postmaster General in making greater use of air transportation to provide for the "more expeditious, efficient and economical movement of mail."

At the same time, the Department asked for authority to contract for the air transportation of mail where necessary at rates different from those set by the CAB.

This met with strong opposition from the Air Transport Assn.

Immediate steps to expand the program were taken by both CAB and the Post Office Department when the Senate Post Office Committee reported that the Postmaster General already has authority to transport all classes of mail by air at rates fixed by the CAB.

Top-level meetings between the two agencies were held to work out details, and Post Office Department estimates of the amount of mail involved and the designation of points to be served were furnished the Board as a basis for determining the rates.

While the CAB can quickly clear the way for expansion of the program by issuing a show cause order, the establishment of a rate for the service may present a problem.

Airlines have not been satisfied with the rates set for first-class mail under the current experiment, although they agreed to cooperate since it was an experiment and since the mail moves on a space available basis. The rate requested by the Post Office Department was designed to be comparable to the cost of surface transportation.

What Airlines Want

Under an expanded program, the airlines probably will want a higher rate, one that is somewhere between the rate paid now for first class mail and the rate set for regular airmail.

The Post Office Department has indicated that since it must operate within its appropriations, it must move the mail by air at rates that will not cause a significant increase in costs over those for surface transportation.

Postmaster General Arthur E. Summerfield and other Post Office witnesses told the committee that, despite the increased use of airlines for moving first-class mail, there will be no significant diversion of mail revenue from the railroads. For the fiscal year ending June 30, 1960, he said, the railroads will be paid an estimated $351,234,000 for

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Northeast Jet Order

New York–Northeast Airlines is expected shortly to announce an order for jet transports, probably the Convair 880. According to President James Austin, the airline may have jets of its own in service by next June. Austin told Aviation Week the order probably will be for seven to 10 airplanes.

The carrier plans to begin jet service on its Miami run in December with Boeing 707-320s leased from Trans World Airlines. Present thinking is that the use of the big leased jets will continue after the smaller jets are in service, with the latter going on other Northeast routes.

mail transportation, $58 million more than that paid in 1956. This, he said, is because of the increased volume of mail plus higher rates.

Summerfield said the proposed program was neither designed to cripple the railroad nor aid the airlines. Its purpose, he said, is to enable the Post Office Department to maintain its standard of service and relieve a critical situation caused by the curtailment of surface transportation.

Joseph P. Adams, executive director of the Assn. of Local Transport Airlines, said his organization strongly supported the proposal to increase the amount of first-class mail to be moved by air and urged that local airlines be utilized to a greater extent in the program.

Adams said the local airlines would not actually profit from greater utilization since the amounts expended for this purpose would reduce subsidy payments by a similar amount. Since subsidy payments are required by local carriers whether transportation of first-class mail is involved or not, this, in effect, would provide improved postal service to smaller communities at a lower overall cost to the government, Adams contended.

Action on contract authority for the Postmaster General–the most controversial issue connected with the airlift of mail–has been delayed.

In its report, the Senate committee concluded that the Postmaster General does not have authority to contract for air transportation to meet special needs at rates other than those fixed by the CAB. As a result, the committee recommended passage of a bill that would give the Postmaster General such authority and contain what the committee termed "reasonable safeguards to insure that such contracts do not produce undesirable conditions in the commercial aviation industry."

Since the bill was introduced late in the session, no final action was taken.

During the Senate hearings, the Air Transport Assn. maintained that such contract authority is not necessary and that it might have a chaotic effect within the industry. ATA testified that every time in the past that a U.S. government agency has been permitted to contract on a competitive basis for air transportation on any substantial scale, the rate levels have been driven down.

ATA President Stuart Tipton cited conditions that existed before passage of the Civil Aeronautics Act of 1938 when mail rates were bid downward "and finally, in a few cases, cases of zero bids were received and accepted."

Tipton said that "procurement practices of the Defense Department have driven the rates so low that the traffic has not made any contribution to airlift development and both the Defense Department and CAB are concerned."

"Tremendous flexibility," ATA said, "can be built into the rate structure fixed by the Board by following the air freight rate structure which provides for reduced rates for high volume and for long hauls, and which provides directional rates in the event of special movements of traffic."

Post Office Department witnesses said contract authority would be used sparingly and that the department would agree to safeguards designed to prevent contract rates from becoming unduly low. They added, however, that they have such contract authority in respect to surface transportation and then, if the department is to move mail expeditiously and without waste of taxpayers' money, at least a normal amount of discretion in the procurement of air transportation is essential.

German Transports Await Funding

Geneva–West German government is expected to make an early decision on prototype funding for two new transports being designed by the German aircraft industry (AW May 25, p. 49).

The proposed aircraft are the 70-passenger twin-jet aircraft designed by Hamburger Flugzeugbau GmbH. of Hamburg, and a 23-seat twin-turboprop plane designed by Ernst Heinkel Flugzeugbau of Speyer-am-Rhein.

Initial request for both projects is about $15 million which would only begin to cover development costs. Further funding by both industry and government would be necessary to support both projects through the initial flight-test stage.

Larger of the two transports is HFB 314, a Caravelle-sized twin-jet design being developed by the engineering team at Hamburger Flugzeugbau. Gross weight of the current 70-passenger configuration is about 80,000 lb. Powerplants will be either two General Electric CJ805-23s or Rolls-Royce RB.141 turbojets. Design cruise speed is Mach 0.9.

Engines will be installed in the fuselage rear as in the style of the Caravelle but may be partially submerged. Final layout of the powerplant bay is not complete, and is being studied by both engine manufacturers and HFB.

Initial plans of the company were to complete the first prototype for flight in late 1961, but the current realistic estimate is one year later, with production deliveries scheduled for late 1963.

First target market for HFB 314 is probably the Caravelle fleet of Air Union, European airline combine of Air France, Lufthansa, Alitalia and Sabena.

Heinkel's transport is a smaller turboprop plane planned as a replacement for the Douglas DC-3. Company sources declined comment on any characteristics of the plane.

French observers are frankly worried about these designs which compete directly with Sud Aviation's Caravelle and Super Caravelle, and with Max Holste's Super Broussard.

They feel something has happened to Franco-German cooperation in the field of aviation.

Government sources in Bonn say nothing is yet firm on the projects, and that funds must be voted by the German Parliament before serious work can begin. Reports elsewhere said West German Lufthansa recommended these two designs but a spokesman for the airline denied that. He told AVIATION WEEK that Lufthansa was in no position to check the design of airplanes but would naturally be willing to test the finished product of any country's aircraft industry. And specifically, he added, Lufthansa had no part in design, development or recommendation of these projects.

Allegheny Ticket Plan Gets Interim Approval

Washington–Civil Aeronautics Board has voted to investigate Allegheny Airlines' proposed discount "book ticket" and "no reservation" fares (AW Oct. 5, p. 41) but has authorized the carrier to go ahead with the plan pending completion of the investigation.

CAB ordered the investigation after Trans World Airlines filed charges that the plan is discriminatory but said there was insufficient evidence to block the proposal at this time. The Board also directed Allegheny to submit detailed figures on the actual operation of the fare plan while the investigation is being conducted.

Capital Reports Convair Jet Plan

Washington—Capital Airlines last week formally announced plans to purchase seven Convair 880-M turbojet and five Lockheed Electra turboprop transports for 1960 delivery as predicted by AVIATION WEEK (AW Oct. 12, p. 41).

Manufacturers' dates call for Electra deliveries in May, June and July, with first scheduled service set for June. Convair 880 delivery dates have been set for October, November and December, with service scheduled to begin in December.

Pilot training for the new aircraft probably will get under way by March for the Electra and July for the Convair. Capital spokesmen say they are interested in obtaining a simulator for Convair 880 transition training but that, since the number of aircraft involved does not warrant the expense of purchasing a simulator, the company probably will lease the equipment.

The agreement of Vickers-Armstrongs, Ltd., manufacturer of the Viscount turboprop, to lift many restrictions, in effect refinancing the mortgage balance of about $37 million now outstanding on Capital's present Viscount fleet, has paved the way for the Convair and Electra purchase, the company said.

Speculation that Capital might purchase the Boeing 707-720 instead of the Convair 880 was mentioned.

Capital President David H. Baker, in referring to earlier speculation that the carrier might shift from the 880 to the Boeing 707-720, said that "in the past three weeks" General Dynamics Corp., parent firm of Convair, made "substantial" changes in its offer to the company, which will allow the 880 to meet many of the advantages offered by the Boeing aircraft. Baker also said financial concessions have been made by General Dynamics that will permit Capital to add a seventh Convair 880 without an additional short-term cash outlay.

Tailored to Capital specifications, the new jets are designated Convair 880-M and will be modified to permit heavier takeoff and landing weights and greater short field capability. Maximum gross takeoff weight of the aircraft has been increased from 184,500 to 191,000 lb.; landing weight from 132,800 to 155,000 lb. and fuel weight from 117,000 to 120,500 lb.

Wing leading edge slats and a larger vertical fin with a power boost rudder will improve the 880-M short field performance, while an improved version of the General Electric CJ-805-3B turbojet engine equipped with thrust reversers and noise suppressors is expected to provide 4% more thrust on 2% less fuel. Other modifications will incorporate such features as preloading baggage bins and track seats.

Financial details of the purchase have not been disclosed by Capital, but financial circles say credit is being negotiated with the Chase Manhattan National Bank of New York, through which Capital originally planned to finance a Convair 880 purchase two years ago. Loan agreement is understood to cover the purchase cost of both the 880s and Electras plus spare parts but not Capital's Viscount mortgage balance of $37 million.

Economy Fares

Washington—National and Northeast airlines last week served notice with Civil Aeronautics Board's tariff section that they plan to drop their special $45 economy class fares between New York and Miami (AW July 27, p. 51) by Nov. 7 or 8.

Eastern Air Lines, which also instituted the reduced fare shortly after National began the service in July, gave no indication as to whether it would follow the same course. Both Northeast and Eastern originally objected to the National plan but told the CAB they would apply the same fare as a competitive measure.

National spokesmen said the service is being dropped because the coach configurations of Lockheed Constellations used on the route are being refitted to handle an expected increase in first class passengers during the winter season.

Hostess Union Sets TWA Strike Date

Washington—Air Line Stewards and Stewardesses Assn. has set a Nov. 8 strike deadline against Trans World Airlines to support its demands for a 70-hr. monthly flight limitation for airline hostesses.

The union contends that the limitation is necessary because of purported physical and psychological after-effects of jet transport flying which, it says, have been borne out by documented reports it has filed with the FAA.

Basis for the complaint and the reports to FAA, the union says, is a series of almost 150 individual complaints that have been filed by hostesses within the last three months. The complaints represent approximately half the stewardesses on jet duty on Trans World, American and Continental airlines, according to a union spokesman.

The ailments listed include ruptured blood vessels, swollen limbs, excess fatigue and changes in menstrual cycles.

In each case, according to the union, the complaining hostesses reported that they began experiencing the ailments approximately 10 weeks after beginning work on the jets. Company physicians who examined the hostesses believe the reported infirmities are of psychosomatic nature induced by a new environment, although some of the complainers have been grounded on the basis of examinations by private doctors, the union said.

FAA medical authorities are inclined to agree with the carriers and say similar complaints were lodged when pressurized aircraft first entered commercial service. They told the union, however, that agency inspectors will conduct in-flight tests of interior cabin vibration to determine if ultrasonic sound waves could have a bearing on the problem.

BEA Plans Interim Helicopter Service

London—British European Airways is planning "interim" helicopter service leading to full-scale operation with the Fairey Rotodyne VTOL, according to BEA Chairman Lord Douglas of Kirtleside. Interim service would not begin for at least a year.

"We shall probably require a couple of 20- to 25-passenger multi-engined helicopters in the class of the American Vertol V-107 and Sikorsky S-61 or British Bristol 192C," Lord Douglas said.

Helicopter Experiment Established by FAA

Washington — Federal Aviation Agency last week formally announced the establishment of an experimental helicopter traffic service designed to attack the problems of all-weather helicopter operations (AW Oct. 12, p. 52).

Daily flight patterns will begin about Dec. 1 from Philadelphia to New York and from Bridgeport, Conn., to the FAA National Aviation Facilities Experimental Test Center at Atlantic City, N. J.

Air traffic control of the agency's fleet of Sikorsky H-37s and HR2Ss will be provided by FAA's control center in New York City. Each helicopter will operate about 300 mi. a day, round trip. Later, a Vertol 107 twin-turbine helicopter will be provided on a cost-sharing basis between the military and the manufacturer.

Experiment may run a year or longer, FAA spokesmen say, and will be primarily concerned with the problems of helicopter air traffic control in high traffic density areas, qualifications of helicopter crewmen, air safety problems, navigation services needed and data on helicopter instrument flying.

SHORTLINES

▶ **Air France** has divided its North, Central American and Caribbean Division into seven separate regions, with each reporting directly to the airline's New York office. The regions and their headquarters are: Northeastern at Philadelphia; Midwestern at Chicago; Western on the West Coast; Southeastern at Washington, D. C.; Southwestern at Houston; Caribbean at Miami; New York in New York City. The French airline recently opened an office in Newark, N. J., and plans to open others in Cincinnati, Indianapolis, Minneapolis, Portland, Ore., and Kansas City.

▶ **American Airlines** flew some 768,000 passengers a total of 552 million revenue passenger miles during September, a 12 and 25% increase respectively over September of last year. The airline reports that during the third quarter of 1959 it carried approximately 2,256,000 passengers over more than 1,691,106,000 revenue passenger miles, up 10 and 21% respectively over the same quarter of 1958.

▶ **Guest Airways of Mexico** has taken delivery of three Lockheed Super G Constellations formerly operated by Thai Airways and will place the aircraft on its Mexico-Europe and Mexico City-Caracas routes. The Super Gs were refurbished by Flying Tiger Line at the carrier's overhaul and maintenance base in Los Angeles. Guest expects the Constellations to cut five hours from the airline's former Douglas DC-6 schedules.

▶ **Hawaiian Airlines** has begun operation of a twice-weekly scheduled service from Honolulu to Midway Island under the terms of a recently signed contract with Air Force's Military Air Transport Service. Flights will leave Honolulu International Airport at 10 a. m. on Monday and Wednesday mornings, returning before midnight the same day. Under terms of the contract with MATS, Hawaiian will transport 72 tons of cargo and passengers each month on the flights through September, 1960. The carrier was awarded the contract on a low bid of $518,391.36 for 108 round trips. Douglas DC-6 aircraft will be used.

▶ **National Airlines** will operate four daily Boeing 707 turbojet round-trip flights between New York and Miami beginning Nov. 1, using a combined first-class and aircoach configuration.

▶ **Seaboard & Western Airlines** has increased its U. S.-Europe mail and cargo service to 13 round trips per week.

AIRLINE OBSERVER

(The following column was compiled by Aviation Week staff members covering the 15th annual general meeting of the International Air Transport Assn. in Tokyo:)

▶ Watch for the trend toward regional pools operating jet transport equipment to spread from Europe—where the European Air Union (Europair) already is established—to Asia and Africa. Exploratory efforts already have been undertaken by Ethiopian Airlines, Ghana Airways, Egyptian Misrair and Liberian Airlines, plus local companies in Nigeria and Sudan, to form a TransAfrican Airways for pooling jet equipment, maintenance and operations. The French are cooperating in the TransAfrica effort, offering the technical assistance of UAT, the French airline which operates primarily to Africa. Formation of an Asian bloc is more complex, with three possible patterns developing. Both Japan Air Lines and Air India are jockeying for domination of a possible pool oriented toward their geographical areas, while a third force emerging is spearheaded by Air Vietnam, which is seeking to form a bloc of airlines such as Royal Air Cambodge of Cambodia, Malayan Airways, Garuda Indonesian Airways and the Union of Burma Airways, with Philippine Air Lines as the leader, providing technical assistance through U. S. channels. Meanwhile, the British Commonwealth bloc is moving fast toward organizing by January, but prospects, including Air India's relation to this bloc, are dim.

▶ **Communist penetration of Southeast Asia via the commercial airlines is growing, with an application by Garuda Indonesian Airways and Air Burma to Communist China for technical assistance in improving their faltering airline operations, seriously jeopardized by the lack of technically trained personnel and modern communications and navigation facilities.**

▶ Thai Airways' acquisition by Scandinavian Airlines System also is causing a sharp look at the possibility of large airlines acquiring new traffic rights through assumption of the bilateral rights of small airlines. SAS, long denied traffic rights to India, may now acquire them by operating Thai Airways' routes. U. S. airlines are particularly resentful of this trend since the Civil Aeronautics Board denies them an equal opportunity to gobble up these plums available to major European carriers.

▶ **Sud Aviation is planning to retrofit its twin-jet Caravelle transport with General Electric aft fan turbojets. Both Air France and SAS are interested in this program which will enable the Caravelle to fly 2,000 mi. stage lengths and offer better block speeds, primarily from a faster rate of climb. SAS now is operating 16 Caravelles with its services to Cairo and Khartoum the longest routes to date.**

▶ Pratt & Whitney Aircraft is raising ratings on the J75 commercial engine (JT4) to 17,500 lb. dry thrust by next July. Current rating of the J57 (JT3) with water injection is 13,500 lb. thrust.

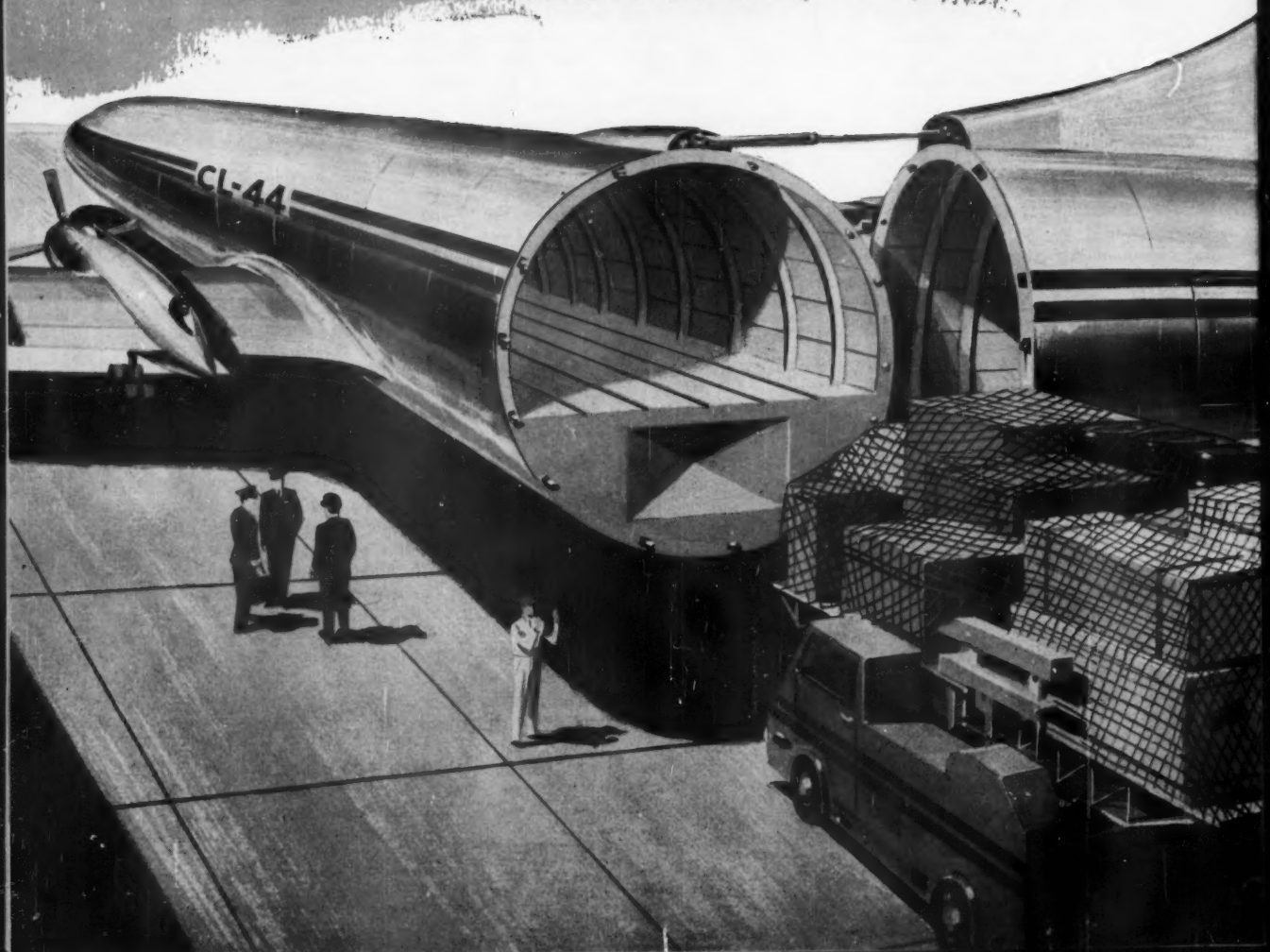
▶ **BOAC reports that the de Havilland Comet 4 missed by only a single day a full year's operation over the North Atlantic route without a serious mechanical delay. An emergency engine change broke the string of 364 days.**

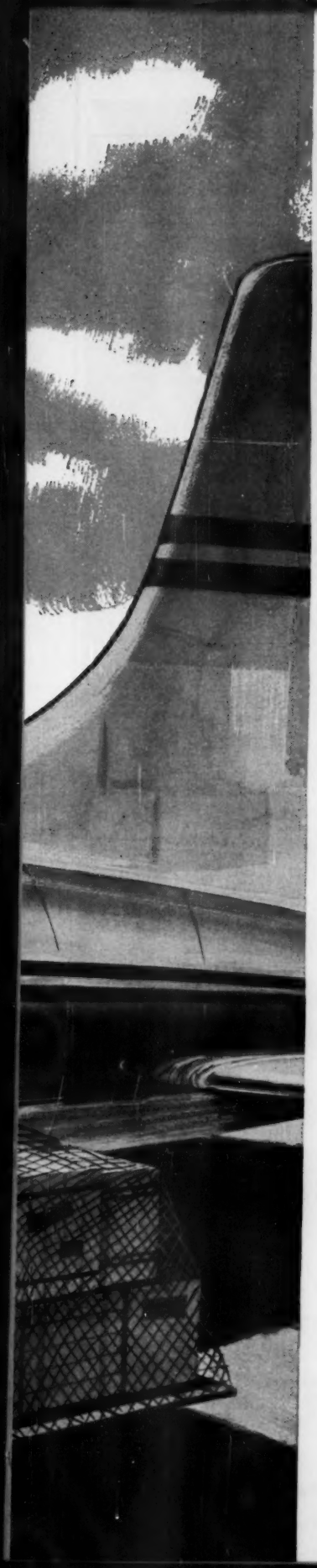
▶ Aviaco, Spanish domestic airline, has purchased five Convair 440s from Sabena to expand its local service and operate an equipment pool with Iberia. Aviaco President Jose Paso Montes also is interested in establishing helicopter service in the Canary Islands. A survey of these routes already has been made with a Spanish military Sikorsky S-55. Montes wants twin-turbine helicopter equipment for these routes.

▶ **U. S. Air Force will continue to fund development of the Allison T61 turboprop engine (AW Oct. 12, p. 34) through Fiscal 1960, with Allison adding considerable private financing to keep the project alive in anticipation of an eventual resolution of the congressional cargo plane controversy.**

▶ British independent airlines, which are offering rates below current standard fares on such colonial routes as London-Hong Kong, are prompting European flag carriers to expand charter service as the only means of competing.

The Breakthrough Air Freighter that *smashed* the cost barrier!





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In this highly important role, the Canadair CL-44 breaks through the transportation cost barrier and will revolutionize the whole air cargo market. It provides direct operating costs of less than 4¢ a ton mile and breakeven load factors as low as 28%, which are both lower than those of any other aircraft anywhere in the world.

The swing-tail CL-44 is already in production for the largest air cargo carriers in the world—Seaboard & Western Airlines Inc. and The Flying Tiger Line Inc.

- Payload—64,000 lbs. • Range—3,000 mi. • Speed—400 mph
- Engines—4 Rolls-Royce Tyne 12 • Cubic capacity—7,391 cu. ft.
- Floor loading—300 lbs. per sq. ft. • Passengers—up to 183
- Span—142 ft. • Length—138 ft. • Cabin length—98 ft.
- Gross weight—205,000 lbs. • F.A.A. takeoff field length—7660 ft.

The Canadair CL-44 is also available as a passenger or as a convertible passenger/cargo aircraft.

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Airline Traffic—August, 1959

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	705,201	567,135	76.3	1,766,920	969,475	8,976,381	66,115,853	63.4
Braniff	173,244	78,014	56.8	315,931	192,907	678,134	8,672,771	47.7
Capital	337,514	137,269	58.0	455,135	309,919	418,359	14,330,325	51.5
Continental	113,247	80,087	62.3	129,722	91,955	228,696	8,110,398	50.8
Delta	255,491	129,461	57.1	386,557	335,252	1,302,122	14,455,206	52.1
Eastern	732,845	402,408	52.92	990,841	596,616	1,460,068	41,734,968	43.20
National	138,882	83,987	55.2	230,663	71,670	511,887	8,903,309	45.5
Northeast	130,396	48,089	55.0	87,576	45,089	109,577	4,847,001	44.3
Northwest	171,338	139,263	63.3	512,385	250,761	1,343,211	15,462,697	54.2
Trans World	484,711	484,052	78.4	1,325,614	817,516	2,432,768	50,951,902	66.7
United	672,512	481,420	74.1	2,390,568	1,203,004	6,240,144	56,025,118	64.7
Western	167,744	96,926	66.3	277,404	101,906	280,367	9,932,100	55.8
INTERNATIONAL								
American	11,959	11,759	72.3	9,689	953	190,658	1,415,120	72.1
Braniff	4,998	9,378	61.0	12,869	.....	99,124	1,128,135	54.5
Caribbean-Atlantic	32,397	2,259	70.0	1,620	.....	4,856	245,491	72.8
Delta	5,046	6,407	58.2	6,517	.....	26,022	745,983	50.0
Eastern	45,182	65,209	66.07	78,039	.....	141,063	6,921,177	62.30
Mackey	12,722	2,539	58.4	.....	84	4,443	276,169	57.6
National	8,057	5,345	56.3	11,490	7,695	36,828	622,374	50.3
Northwest	21,608	41,654	64.8	1,114,186	24,698	1,037,496	6,544,746	67.1
Pan American								
Alaska	7,261	7,348	73.2	32,330	.....	187,276	1,014,255	70.1
Atlantic	137,347	191,337	76.5	1,220,673	.....	2,778,152	23,925,126	65.2
Latin American	138,057	160,420	78.8	396,185	.....	4,606,021	19,997,235	72.2
Pacific	35,427	136,636	86.9	1,281,746	.....	2,178,276	17,562,530	79.3
Panagra	11,404	17,648	66.1	67,750	.....	473,885	2,435,253	64.6
Resort	58	241	27.2	.....	.....	1,758,985	1,788,393	77.6
Trans Caribbean	10,392	16,438	88.5	.....	.....	327,902	1,657,708	80.0
Trans World	42,388	134,989	73.0	825,423	.....	1,987,765	16,653,011	69.9
United	15,814	39,291	90.0	155,494	.....	100,551	4,275,284	85.9
Western	5,430	8,443	73.0	13,598	.....	13,039	911,242	73.4
LOCAL SERVICE								
Allegheny	58,920	10,580	50.7	10,982	23,616	34,723	1,079,600	48.7
Bonanza	20,128	4,977	44.2	5,861	2,192	10,371	493,187	42.6
Central	14,954	2,972	38.8	6,491	4,263	11,206	306,644	35.1
Frontier	33,373	8,588	40.3	23,482	11,117	75,545	937,323	44.6
Lake Central	20,084	3,169	38.9	4,126	21,645	.....	328,062	42.6
Mohawk	46,798	9,321	54.1	9,373	17,072	17,991	933,633	54.2
North Central	90,628	16,556	47.78	34,157	53,195	32,618	1,727,811	48.45
Ozark	49,529	8,561	43.3	13,889	30,633	36,303	899,003	46.2
Pacific	46,620	10,252	60.7	16,849	6,018	10,904	1,011,256	59.6
Piedmont	45,605	9,811	47.2	17,406	15,895	19,668	994,052	48.2
Southern	16,948	3,069	38.6	6,651	8,681	13,878	323,545	39.4
Trans-Texas	26,801	6,451	39.4	17,855	10,791	37,315	683,903	40.0
West Coast	34,472	7,559	46.83	8,618	4,575	16,142	751,259	47.99
HAWAIIAN								
Aloha	41,436	5,996	71.1	2,627	.....	5,774	496,037	67.2
Hawaiian	58,669	10,745	66.0	2,732	.....	148,328	1,051,443	64.2
CARGO LINES								
AAXICO*	.....	.....	.....	.....	.....	509,716	509,716	86.7
Aerovias Sud Americana	.....	.....	.....	.....	.....	509,716	509,716	86.7
Flying Tiger	3,048	13,317	98.9	31,097	61,135	9,985,239	11,409,180	85.1
Riddle								
Domestic	.....	.....	.....	4,901	29,764	1,128,930	1,163,595	70.7
Overseas	.....	.....	.....	1,366	.....	428,904	430,270	68.1
Seaboard & Western	181	737	.....	371,361	.....	2,066,409	2,516,561	56.9
Slick	3,731	23,842	98.26	.....	.....	4,129,667	6,513,926	99.11
HELICOPTER LINES								
Chicago Helicopter	21,435	391	57.3	1,233	.....	.....	38,484	47.4
Los Angeles Airways	5,863	194.5	62.9	4,375	2,354	.....	25,283	70.4
New York Airways	14,897	290	57.3	1,418	1,077	608	30,752	55.7
ALASKA LINES								
Alaska Airlines	10,840	9,538	63.7	58,096	4,710	393,512	1,403,510	63.0
Alaska Coastal	8,577	862	60.6	3,624	.....	6,051	96,962	63.5
Cordova	1,983	293	41.5	4,896	.....	49,642	84,700	47.9
Ellis	7,578	486	63.4	1,978	.....	4,049	55,173	71.9
Northern Consolidated	3,988	1,296	57.0	33,389	.....	70,587	243,701	68.7
Pacific Northern	17,396	17,061	68.2	111,969	7,722	328,774	2,293,197	74.5
Reeve Aleutian	1,663	1,404	39.7	38,818	.....	71,695	263,197	59.4
Wien Alaska	6,885	2,711	40.6	39,998	.....	320,126	633,983	54.2

* Not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

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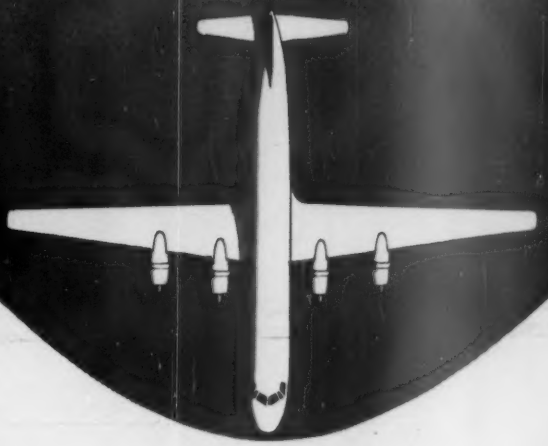

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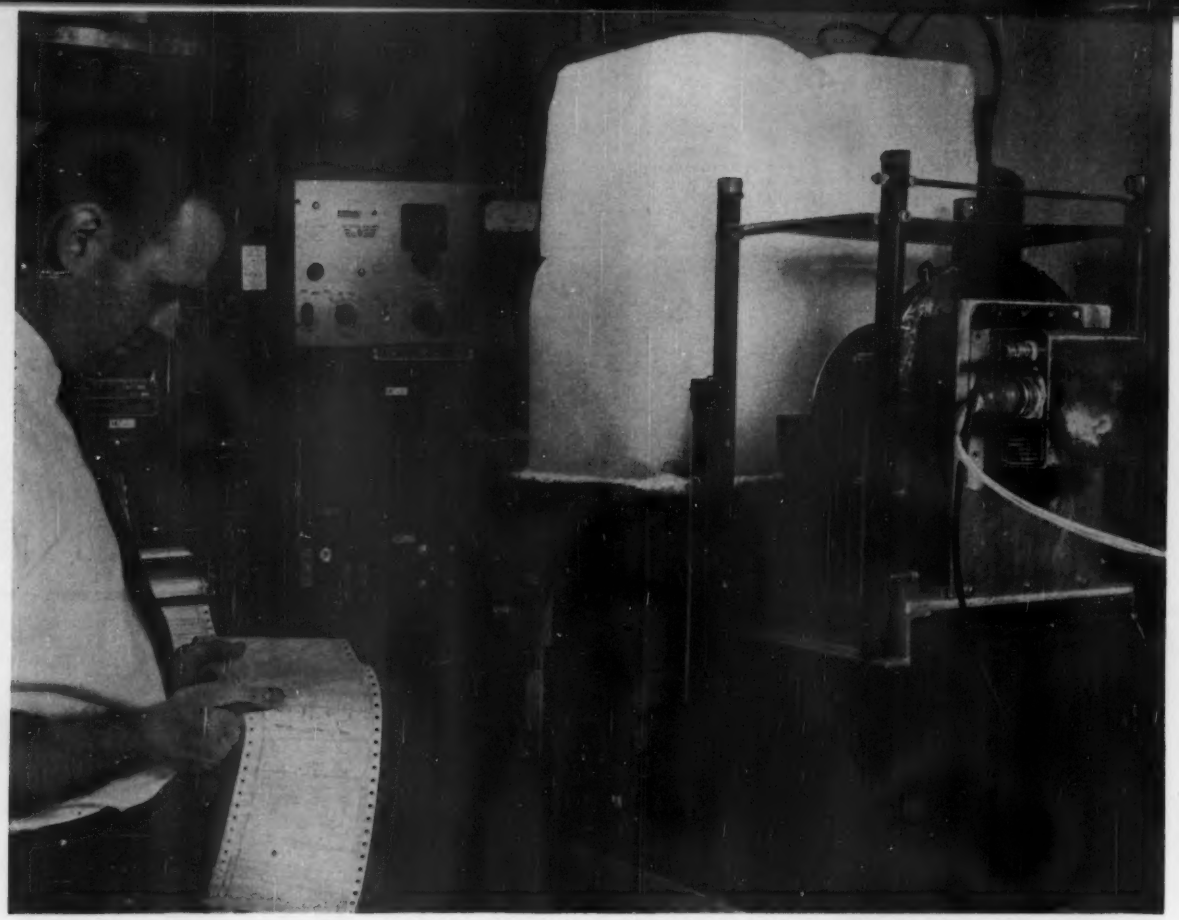


TESTING of infrared horizon sensors for use in space vehicles was accomplished in the rig above. Infrared-sensing unit is mounted on the plate at right in the photo. It is scanning the blocks of dry ice at center, with the horizon simulated by a black semicircular plate between the ice and the infrared-sensing unit.

Nose Cone Tests Pay Space Lab Bonus

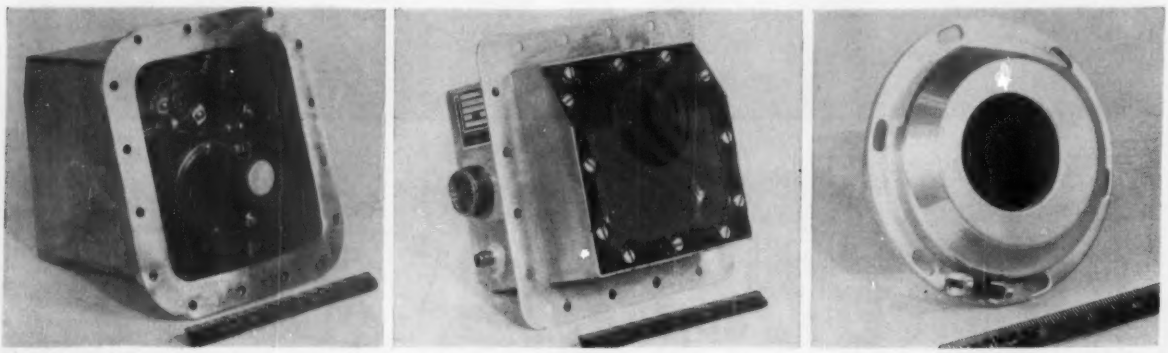
By J. S. Butz, Jr.

Philadelphia—Development testing of equipment for space vehicles and for measuring physical phenomena in space has been an important bonus in the flight test program of the General Electric Mark 2 heat sink nose cone, the first Air Force IRBM and ICBM warhead to become operational.

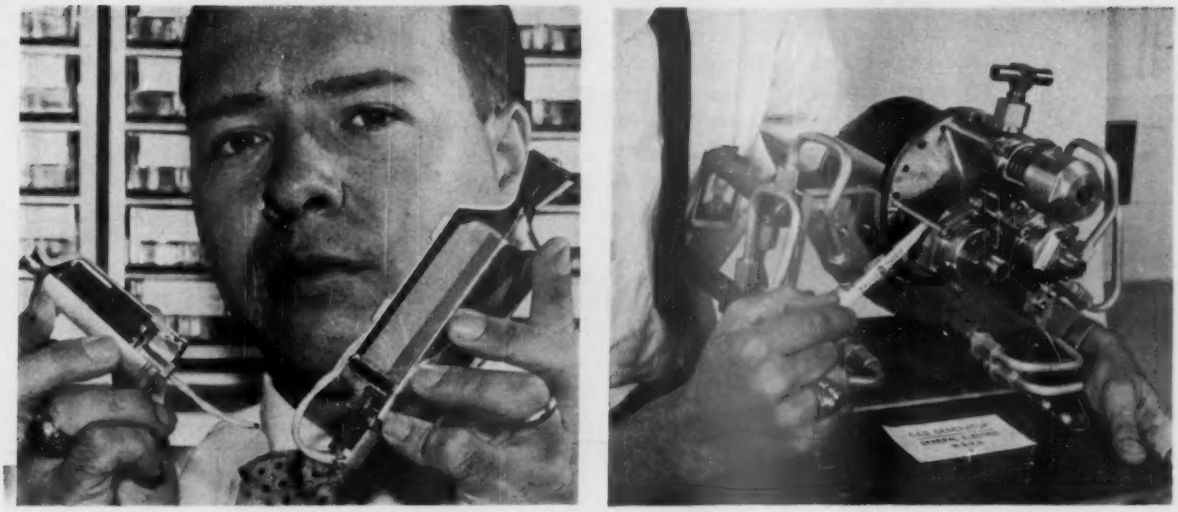
A wide variety of control, navigation and power subsystems for space vehicles plus instrumentation for making basic scientific observations above the atmosphere has occupied the space normally reserved for a nuclear weapon during many of the developmental firings of the Air Force Thor and Atlas missiles.

This program to take maximum advantage of ballistic missile tests has been termed "piggy-back" by the Air Force; General Electric calls it the Space Lab concept. General Electric's Missile and Space Vehicle Department has developed 18 different internal configurations of the Mark 2 nose cone to carry this instrumentation and equipment in a program parallel to the primary task of designing tactical configurations for the ballistic missile reentry vehicle.

Primary purpose of all the Air Force



DEVELOPMENT of the suntracker units which provide a reference for space vehicle navigation and attitude control systems is shown from left to right. First units weighed more than six pounds. The present model on the right weighs less than one pound and is accurate to about 0.2 deg.



SPIN ROCKETS used to turn satellites rapidly about one axis so they will be stabilized during re-entry into the atmosphere are at left. The small unit produced 15 lb. sec. of impulse while the larger one is rated at 48 lb./sec. Each has a one-second burning time. Both units have end-burning grains. Small thrust forces from six separate nozzles that are needed for fine attitude control of a satellite in orbit can be provided by the small solid propellant gas generator at right. The end-burning grain has a usable impulse of 250 lb./sec. and a burning time of 10 sec. Thrust can be provided in small bursts over a long period, however, since the generator is controlled by on-off solenoid valves.

IRBM and ICBM tests thus far has been to test and perfect a weapon system, but the adoption of the piggy-back principle also has enabled these firings to contribute materially to the rapid introduction of a new era in development testing. Test capabilities of this new era are vital in the development of reliable space vehicles, and they are now being planned in detail by the military services and the National Aeronautics and Space Administration.

Satellite test laboratories for space vehicle equipment and systems will be the main addition to existing development testing techniques. These satellite laboratories will stay aloft for months and will automatically cycle the equipment under test through many simulated space missions. While elaborate ground installations are now being built to simulate much of the space environment, there is no way of completely duplicating space conditions on earth.

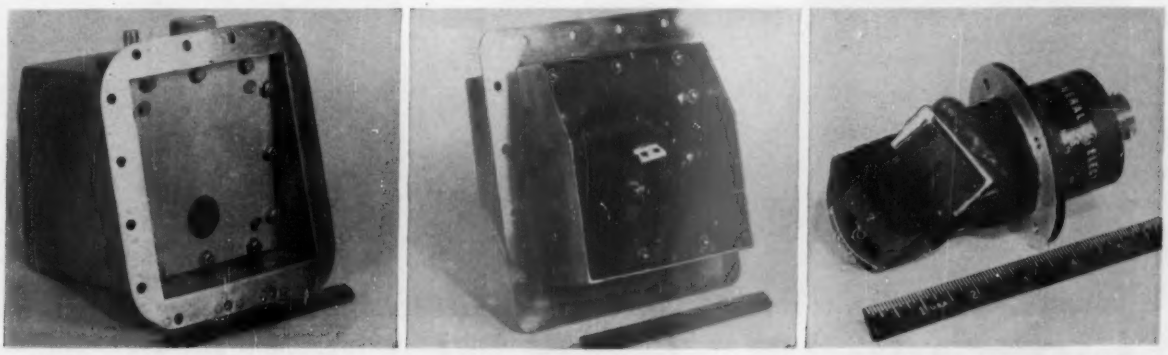
Ground laboratories will allow close observation of test work and greatly facilitate the initial development of space systems, but the satellite laboratories will do the final proof testing in the true environment over time periods relative to useful space flight durations. Satellite laboratories would be recoverable and allow first-hand examination of any equipment that malfunctions. This feature also provides conclusive proof that any system which operated properly according to the telemetry data was entirely undamaged after its trip through space.

NASA has indicated by congressional testimony that manned satellite laboratories will be necessary in the future as propulsion capacity increases.

First of the unmanned satellite laboratories has already been fired in the Discoverer Program managed by the Advanced Research Projects Agency. The recoverable portion of this vehicle, known as the Satellite Aeromedical Recovery Vehicle (SARV), was also designed by the Missile and Space Vehicle Department.

SARV has a life support system which can keep small biological specimens alive for 54 hr., and equipment for ejection from orbit, thrust vectoring and recovery. Design of the life support system allows 12 hr. for the pre-launch phase, 27 hr. in orbit, 10 hr. for recovery operations and 5 hr. for return to base.

In six firings during the Discoverer



LATEST infrared horizon sensor which has flown in Space Lab experiments is shown in center. It weighs 10 lb. and includes a small computer which converts sensor readings into the signals needed to actuate an attitude control system. Newest sensor-computer unit is at right. It weighs about 2 lb. and takes about 25% of the volume required by the center unit. First GE infrared sensor unit is at left.

AN ASW SYSTEM... DISPLAY/AIRBORNE RECEIVER/SONOBUOYS

Anti-submarine warfare equipment designed, developed and produced by *The Magnavox Company*, in conjunction with the Navy Department, provides patrol aircraft with eyes that see underwater by day and by night. The AN/ASA-16 Display System, together with SONOBUOYS, AN/ARR-26 Receiver systems and other associated equipment provide aircraft with a clear picture of the ocean-depths below them. They are part of the continuing contributions of *The Magnavox Company* in aiding the U.S. Navy to combat the growing submarine menace.

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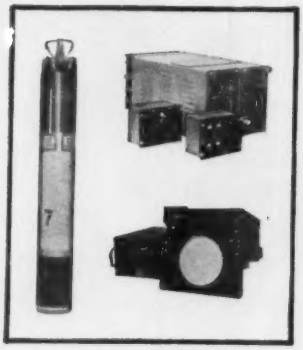

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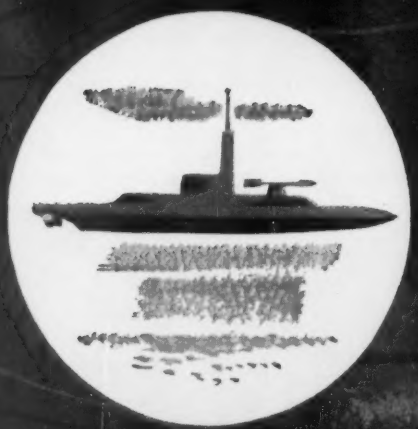

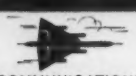
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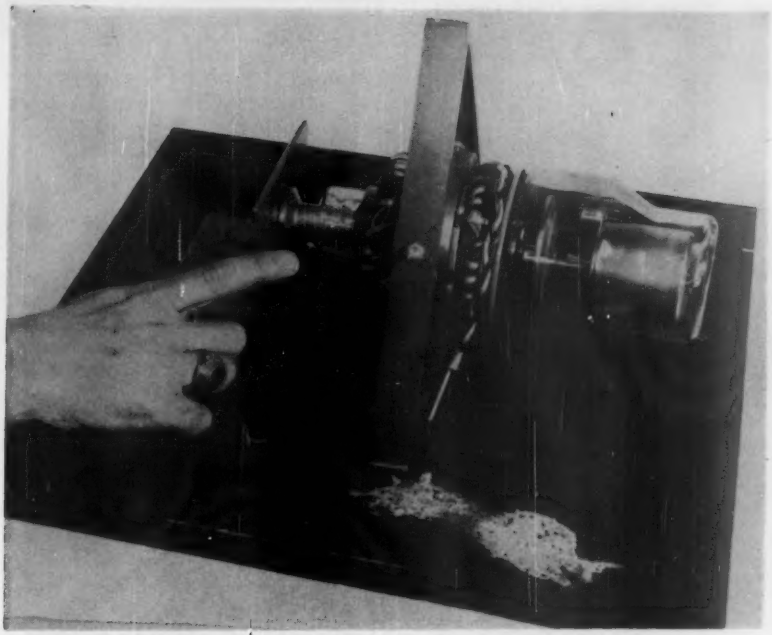
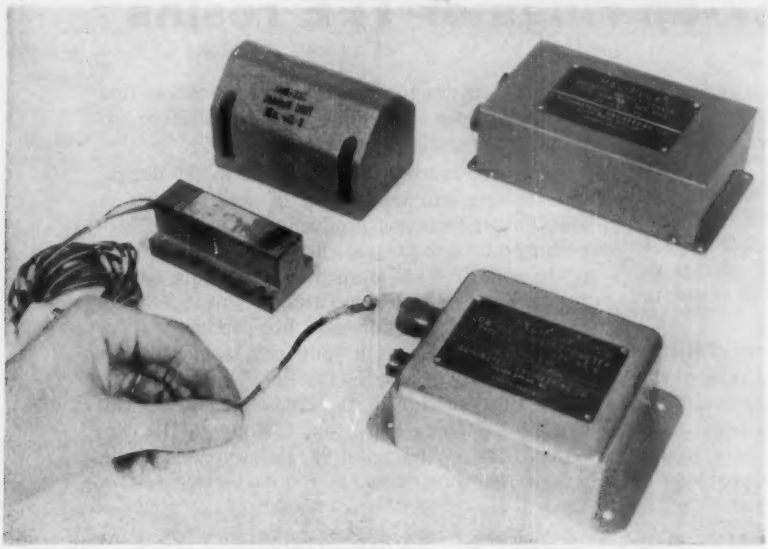


VACUUM BEARINGS for use in space have been designed by General Electric and used in equipment such as this rotating anode tube. Bearing utilizes a silver plate for lubrication and is capable of operating at 3,300 rpm. for 2,000 hr. at temperatures as high as 650C and a vacuum pressure equal to that in space.

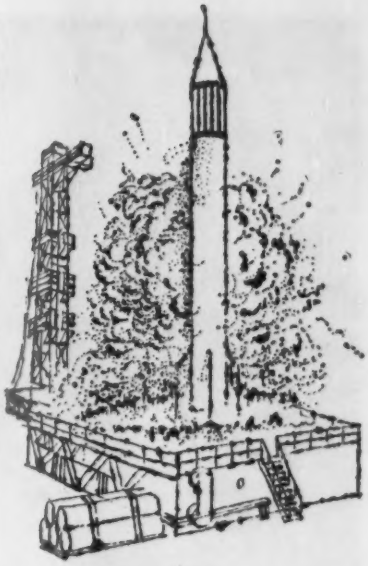
program, five attempts have been made to bring part of a satellite back from orbit.

Two of the Discoverer vehicles never achieved an orbit. Discoverer II, which was the first to orbit, was not a complete success because the re-entry vehicle was ejected prematurely and fell near Spitzbergen, instead of in the Pacific as planned. This vehicle was spotted falling in its parachute, but without prepared recovery crews it was not retrieved. Subsequent re-entry vehicles from the Discoverer V and VI satellites were not recovered either.

These satellites were of considerable value, however. The satellite stabilization system functioned properly on all of the four flights where it had a chance to operate. Other test projects connected with the control of military satellites, listed as "advanced engineer-



MAGNETOMETERS may prove to be the basic sensing units for future missile and space guidance systems. Three units in background measured general strength of magnetic fields in space around earth during nose cone development flights from Cape Canaveral. Unit in foreground was later used to control warhead by sensing these fields.



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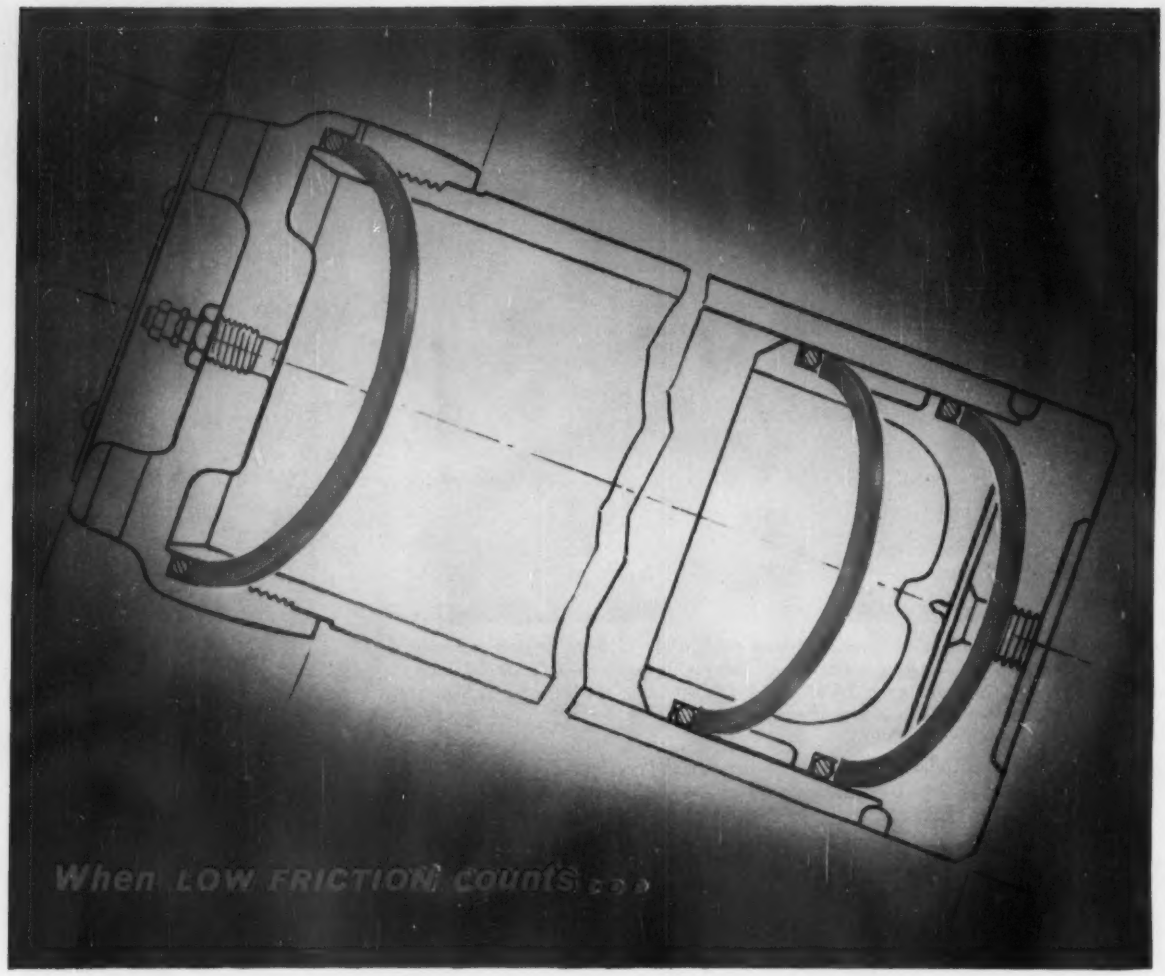

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To reduce frictional drag to a minimum and to prolong the life of O-rings, three back-up rings of TEFLON TFE resins are used in the accumulator of a hydraulic cranking system (shown above). The accumulator operates at pressures up to 3,000 p.s.i. and the back-up rings of TEFLON TFE resins prevent the extrusion of the relatively soft O-rings. In operation, some of the TEFLON TFE resin is deposited on the O-rings as they move about the groove, further reducing friction drag.

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Space Lab Log

A summary of special tests conducted with Mark 2 and RVX series of re-entry vehicles on a non-interference basis from Cape Canaveral by General Electric's Missile and Space Vehicle Department for USAF organizations under the sponsorship of the Air Force's Ballistic Missile Division.*

Experiment No.	Purpose of Equipment
1E1	Evaluation of IR sensors and open-loop attitude measurements with free gyros.
1E2	Magnetometer and sun tracker, open-loop attitude measurements with free gyros.
1E6	Two-axis stabilized using IR sensors for pitch-yaw; data capsule with camera.
1E6A	Same as IE6 plus solar cells.
1E7	Three axis stabilized with IR sensor and sun tracker; data capsule with camera.
1E7A	Same as 1E7.
1E7B	Same as 1E7, plus orbit circularization system test.
1E8	Same as 1E7 except using a magnetometer instead of a sun tracker.
1E8A	Same as 1E8.
J1	Emulsion packages.
J2	Three part program for low level, low frequency acoustic noise and vibration analysis.
J3	Micrometeorite grids.
J5	Measure of atmospheric density.
J6	Radiation sensor for re-entry shock measurements.
J7	Electric field measurements.
J8	Ion and electron-density probe.
J9	Calibrated aneroid micrometeorite detector.

* There were no failures due to installation or use of the GE-MSVD space lab equipment.

ing tests" by the Department of Defense, were also performed with success.

The expanding Air Force "piggyback" program, which has been operational for almost a year, has produced a large body of information and a number of important firsts in its space laboratory role. The weight of test equipment in these ballistic missile flights is well above that permitted on the most powerful sounding rockets. The testing times in space are also much longer during the flight of the re-entry vehicles for the weapons, with almost 25 min. available during an ICBM flight.

In this program, the GE Missile and Space Vehicle Department made the first infrared measurements of the interface between earth and space from very high altitudes in the fall of 1958, made the first successful magnetic flux

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measurements from space last March and accomplished the first three axis stabilization of a vehicle in space in July.

This latter achievement had added significance because the sensing units and computers used were adequate for interplanetary flight. Infrared sensors and a suntracker were the sensing units for this stabilization system.

GE space laboratory program is divided into two main segments. One is involved in the development of equipments, and the other is concerned with basic research and the recovery of basic information regarding the space environment and vehicles traveling through that environment. The two main projects in the equipment and subsystems development phase are space power and navigation and control.

Navigation and Control

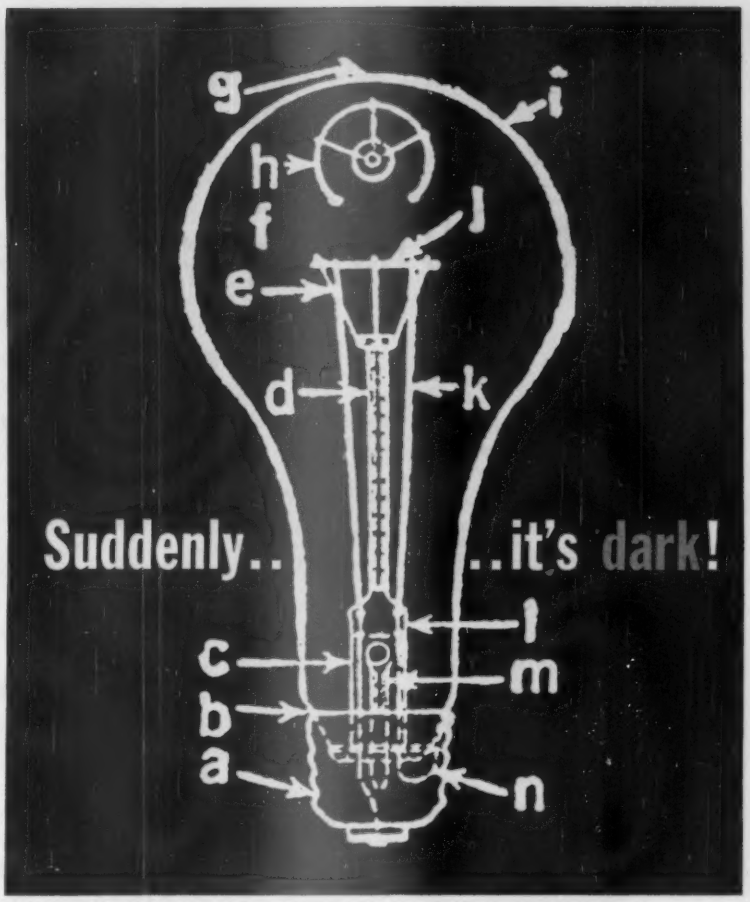
The heart of a navigational and control system, the sensing units and computers which are being developed by the Missile and Space Vehicle Department, can be used in most cases on vehicles for interplanetary and lunar missions as well as for earth satellites. These major components include infrared sensors, magnetometers, sun trackers, star trackers, high altitude radar altimeters, data comparison computers, and orbit correction computers.

In most cases, computers have been built into a single small case with the sensing unit. Extremely small units have been achieved which will not only acquire and keep a reference for a vehicle, but will provide the signals needed for a control system to hold a given attitude. General GE philosophy in this type of development is to get something to work, then to miniaturize it in steps.

Computer Example

In the case of the company's infrared sensor computer unit, it started out weighing several pounds and has been improved twice so that the present model weighs less than 2 lb. It is accurate to less than 0.2 deg. and exists in two basic types. One scans through 90 deg. and the other through 360 deg., with the latter designed for use on a vehicle which would be a very great distance from a planet. The infrared sensors have been tested during several flights in the last year and have actually been used in the stabilization of operational type ballistic missile nose cones during a portion of at least six flights.

Missile and Space Vehicle Department also is deeply involved in the development of systems which made use of the earth's magnetic field to guide missiles and space vehicles. The department has experimented principally with two types of magnetometers



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One day soon the U. S. Navy will file a report more fantastic than any sea serpent tale we've ever heard. This will be the launching of the Navy's spectacular Polaris missile from a submerged nuclear submarine. Advanced testing is underway; the Polaris will be ready for the fleet in 1960.

Smaller and lighter than other intermediate range ballistic missiles, this formidable Lockheed developed weapon features much that is new in advanced electronics. It even "thinks" for itself.

One such "think" device aboard the Polaris is a system developed by Donner Scientific Company using as a base a standard Model 4310 Accelerometer. The system monitors flight performance like a policeman directing traffic. If, for example, in the initial portion of the flight, the missile does not achieve sufficient velocity by a pre-determined time, the Donner system aborts the flight. The missile gets the go-ahead only as programmed.

Donner's role in the Polaris project represents another basic contribution from an engineering team which specializes in accurate systems, interlocking time, acceleration, velocity and other inputs designed to meet customers' requirements.

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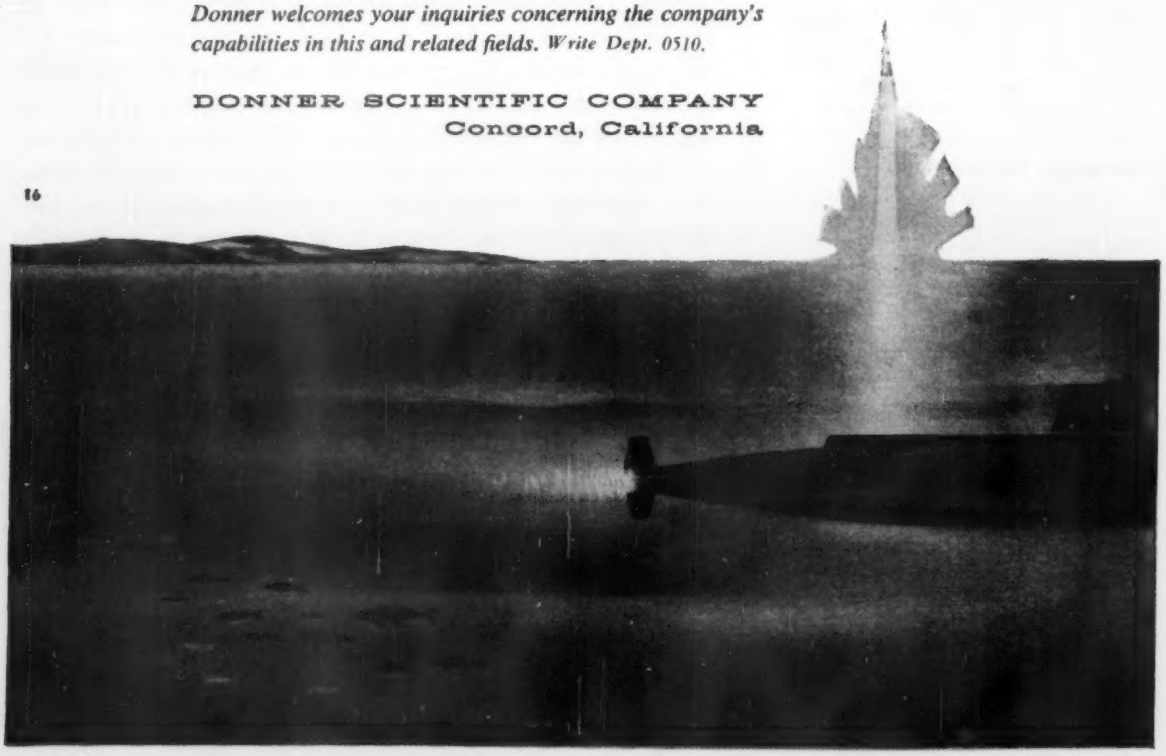

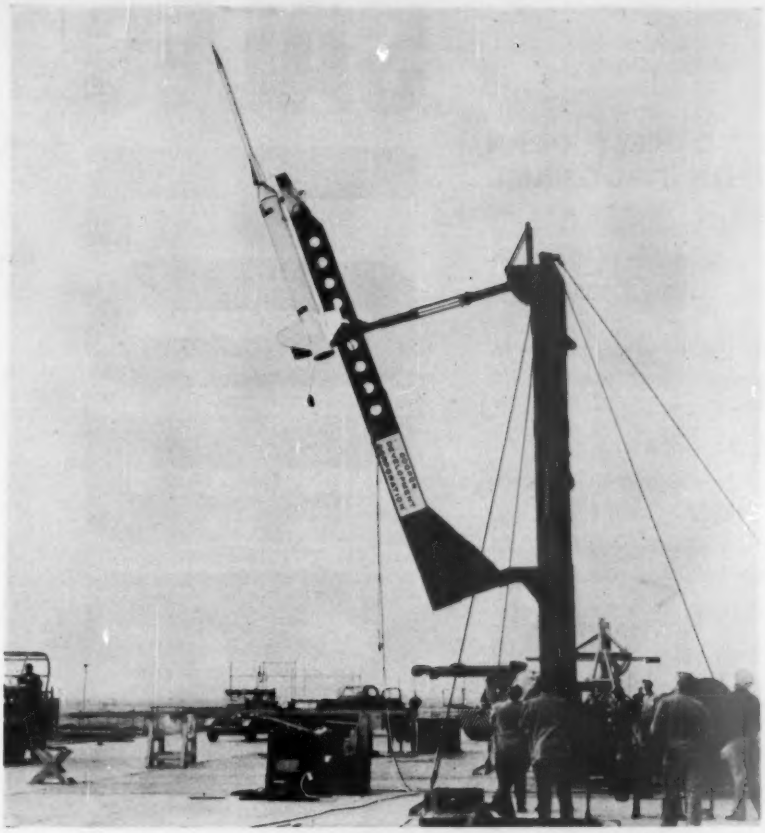

ASPAN Rocket Probes Upper Atmosphere

Firings of 70-lb. payload to 145 mi. to determine wind direction and velocity over the range of the sounding rocket, and to measure rate at which matter disperses in upper atmosphere, are being conducted by NASA at Wallops Island, Va. Rockets, built by Cooper Development Corp., are Asps with Nike boosters. Note crane-like launcher.

to serve as sensing units for such systems—the flux-gate and light pump magnetometers.

Apparently the best prospects now lie with the light pump type because it has shown the potentiality of operating in field strengths down to 10 gammas with an accuracy of 1%. The upper limit on this device is around 60,000 gammas, which is about the same as the flux-gate magnetometer. However, the flux-gate type has a lower limit of about 1,000 gammas, and there are some doubts about holding the accuracy of this instrument under flight conditions.

A number of problems still remain with the light pump magnetometer, but there is a distinct possibility that it can be developed in a short time into a direction sensing instrument for space ships, very high speed gliding missiles and boost glide aircraft which is accurate to less than 1% and weighs less than one pound. Such a device would have an effect on the design of all types of guidance systems.

This magnetometer has flown in prototype form a number of times in an open loop situation during which it was checked for accuracy, response, and other factors. It has also made two closed loop flights in which it contributed to the orientation of a re-entry vehicle.

The sun tracker presently used by GE is a very simple device. Basically, it is a small box with a slit in it and a strip of light-sensitive material is placed behind the slit. There is a break in the strip so that if the sunlight falls directly through the slit, it will not strike the sensitive material. If the sunlight comes in at an angle, it strikes the strip and causes a current to flow through it. This current is used to actuate a control system which can bring the vehicle carrying the suntracker back into proper alignment with the sun.

This instrument has been used several times to stabilize a ballistic missile re-entry vehicle in roll. It weighs about one pound in present form and is accurate to about .2 deg. in the vicinity of the earth.

Last spring, after the feasibility of the sun tracker had been established, the Missile and Space Vehicle Department

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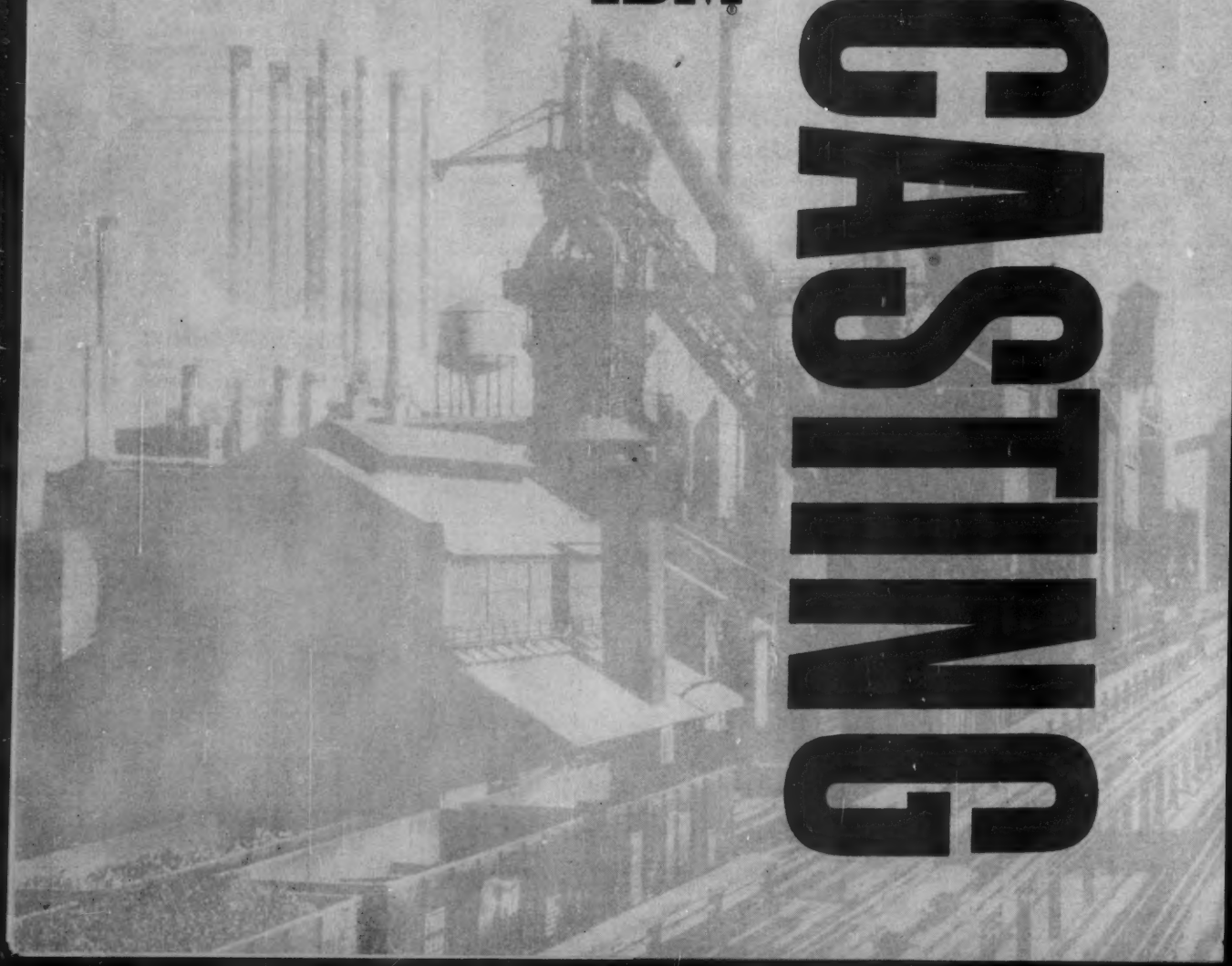


began converting the basic instrument for use as a star tracker. This project is still in the feasibility study phase.

Missile and Space Vehicle Department is working on a number of power supply units for a variety of space missions. Chemical, nuclear and solar energy sources are under investigation for these power units, which include chemical batteries, electrolysis fuel cells and thermoelectric and thermionic converters.

Batteries' Advantages

When short-term applications in space are considered, batteries are among the best power sources as far as reliability, low cost, and power-to-weight ratio are concerned. GE now has batteries which produce 36 watt-hr. per pound at a one hour discharge rate and is trying to bring this number up to 60. The highest theoretical value is 120 with a silver oxide-zinc battery. At a 100 hr. discharge rate it may be possible to get 80 or 100 watt-hr. per pound.

Fuel cells in which electric power is produced as part of a chemical reaction are in a breadboard state of development.

They will produce 200-watt-hr. per pound on an eight-day mission. Since the weight of the fuel is the only part of the power unit which would increase for longer missions, it would be possible to get 1,000 watt-hr. per pound on a 30-day trip.

Thermoelectric and thermionic devices are being studied which would employ a collecter to focus the sun's rays and provide the heat needed for their operation. The thermionic type is now considered best for this type of power unit. In the thermionic device, the flow of electrons between the heated cathode and the cooled anode can be maintained with a relatively high anode temperature. This cuts the requirement for a large radiator in the cooling system well below the size required for many proposed space power systems. Some of these advanced systems require a square foot of radiator for every 60 watts of power, while the thermionic unit will need only one square foot per 200 watts of electrical output.

Conversion Efficiency

It now appears possible to eventually show a 30% conversion efficiency with a thermionic unit, but currently only about 10% is being achieved. The same ultimate efficiency is believed possible for the thermoelectric units which probably will be employed best with a nuclear isotope energy source.

A major portion of the Space Lab program is directed toward making basic physical measurements above the atmosphere. Information of this type gained through many nose cone development shots provides a very valuable check on satellite, balloon and sounding rocket data. It also makes statistical studies possible at an earlier date.

Measurements made so far have evolved radiation, micrometeorites, electric fields and atmospheric density. The radiation experiments have been made with emulsion packs on which radiation particles leave a trace which can be studied later on the ground.

Fine wire coils in parallel are placed on some of the outer portions of the reentry vehicles to indicate the presence of meteorites. Impact is indicated by the voltage drop through the coils. In two cases, meteorite showers 2,000 ft. long have been found, but they caused no serious damage to the nose cone.

Electric field measurements have shown that the charge on a ballistic missile nose cone is 5 to 10 times greater than originally predicted. This

USAF Launches First Robin Sounding Rocket

First launching of Air Force's Robin sounding rocket is conducted at the Atlantic Missile Range. Robin (Rocket Balloon Instrument) consists of an Atlantic Research Corp. Arcas rocket carrying a deflated weather balloon. The four-ounce balloon was boosted to an altitude of 240,000 ft. At peak altitude an explosive device separated the balloon from the rocket. The balloon was then inflated to its 3-ft. diameter by iso-pentane gas contained in a one-ounce vial in the balloon. Launching was one of several tests to check out Robin as a means of obtaining high-altitude wind and air density data. The balloon is fabricated from Mylar transparent plastic material. Three planes of aluminized Mylar are attached inside by small springs to form a set of eight corner reflectors which permits continuous radar tracking. Data gathered by the tracking radars is used to compute wind velocity and high-altitude air densities. Robin was developed by Air Force Cambridge Research Center and Office of Naval Research. The balloon is produced by G. T. Schjeldaha, Northfield, Minn.

caused a corresponding increase in electric drag.

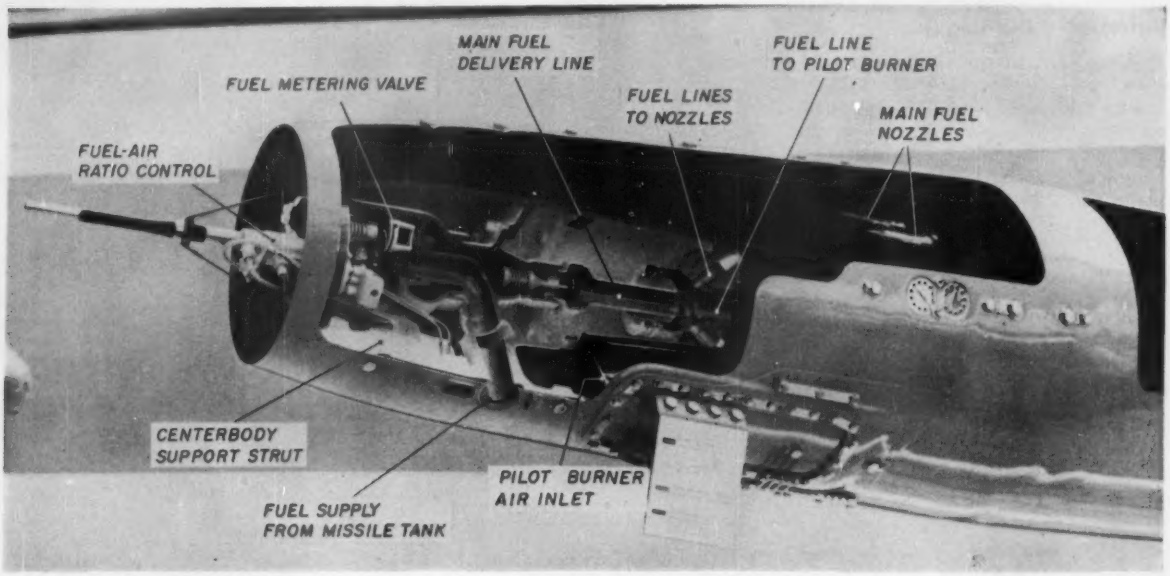
One of the next Space Lab instruments to be flown is a cold cathode ionization gage which will measure atmospheric density. The space between the anode and cathode in this gage is open to the atmosphere, and its ability to conduct a small current will be in proportion to the density of the atmosphere.

Westinghouse Designs Space Metal Process

Pittsburgh—System of metal powder compression to construct large metal objects from high temperature materials used in space vehicles, rockets and missiles has been developed by Westinghouse engineers here.

Process involves metal powders such as tungsten, molybdenum and other alloys which are compressed into metal bars and then baked.

The compaction process was developed by Charles Deibel and Frank Emley. Supply of powder is fed into three-sided trough into which it is pressed by a descending plunger. Plunger follows the powder down the trough, bringing the powder from an intermediate to a final compressed state.



CUTAWAY Bristol Siddeley BT-1 Thor ramjet was shown for first time at 20th SBAC display at Farnborough. Engine powered early version of the Bristol-Ferranti Bloodhound, has since been replaced by more sophisticated version of Thor. Engine thrust rating has been given as about 16,000 lb. at Mach 3 and sea level, but figure is misleading because it does not represent a typical condition for the ramjet.

British Show Details of Thor BT-1 Ramjet

Farnborough—First details of a British ramjet engine were shown in cutaway of a Bristol Siddeley BT-1 Thor powerplant at the 20th Society of British Aircraft Constructors Flying Display and Exhibition.

BT-1 is an early version of the ramjet engine now powering the production Bloodhound. The engine has a central body, supported in an annular diffuser by three struts spaced at 120 deg. Nose cone of the central body protrudes ahead of the sharp-lipped cowl. Function of the conical nose is to force an inclined shock wave and to focus it to decay on the cowl lip.

Airflow Path

Inlet air passing through the single inclined shock is slowed and turned. It enters the cowling at low supersonic speed and passes downstream through the annular diffuser around the central body. Just downstream of the minimum-area section of the diffuser, a normal shock is formed and held, changing the flow velocity from supersonic to subsonic. Further subsonic diffusion takes place, as the air moves downstream, to reduce its speed to an acceptable value at the inlet to the combustion chamber.

Inlet designs of this type maintain high efficiencies up to Mach numbers on the order of 2.5, perhaps stretchable to Mach 3 without unbearable losses.

Main fuel supply comes to the engine from missile body tanks, arriving in the central body through a single line in one of the supporting struts. It passes through a fuel metering system which is monitored by a fuel-air ratio control system. This type of system works by sensing the pressure ratio across the shock system, which is uniquely determined by the forward speed of the engine. Any variations in speed change the shock pattern and therefore the pressure ratio across it.

For maximum efficiency, the inclined nose shock must be kept focussed on the cowl lip; if it is allowed to move either upstream or downstream, the entire engine cycle can become unstable.

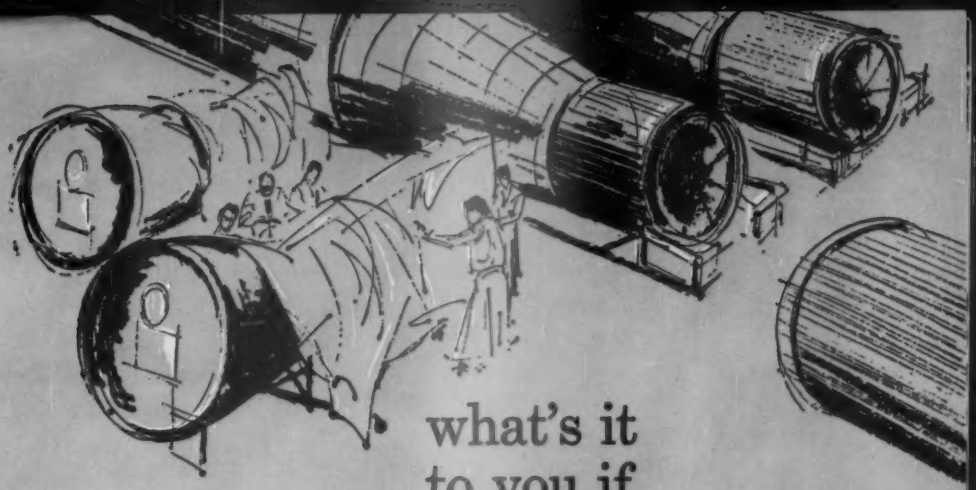
Metered fuel passes out of the control system and goes through a central line in the body to the main fuel injectors and to the pilot burner on the thrust axis.

This pilot burner is air-fed through three separated intakes which draw air from the channels between the support struts of the center body. Pilot-burner air is swirled by vanes in the intake system, so that maximum mixing of fuel and air takes place in a short distance.

Main Fuel Nozzles

Main fuel nozzles are in three groups of four jets, each group attached to the trailing edge of a center body support strut. Flame is held and stabilized by a Vee-gutter type of annular flame holder downstream of the main fuel injectors and attached to the rear of the air intakes for the pilot burner.

Combustion chamber is lined with a perforated screech damper to minimize that form of combustion instability. A convergent-divergent nozzle at the exhaust end of the combustion chamber produces supersonic exit velocity.



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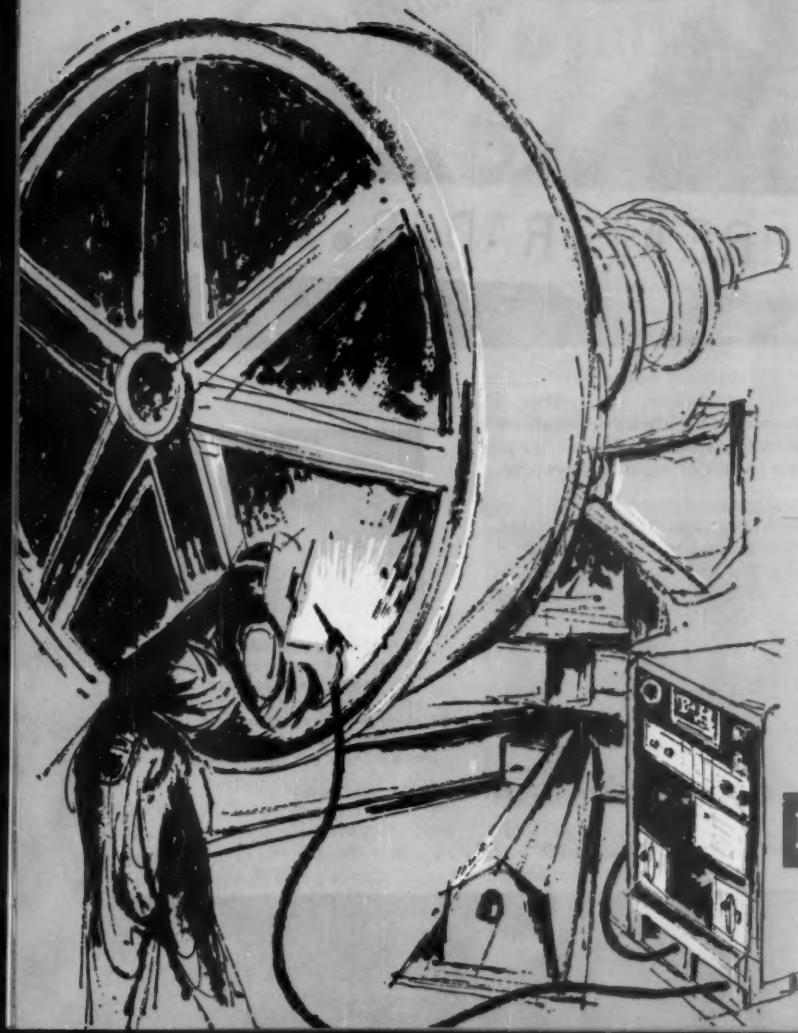

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Other airborne electronics projects include:

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- Radar-Infrared Search-Track Set AN/ASG-13
- High Resolution Experimental Bombing System AN/APQ-49

Radar Systems Engineer, F. N. Bellew, now assigned to an advanced search and bombing radar system, has 15 years' experience in airborne electronics, including microwave systems, video amplifiers and cathode ray tube displays.

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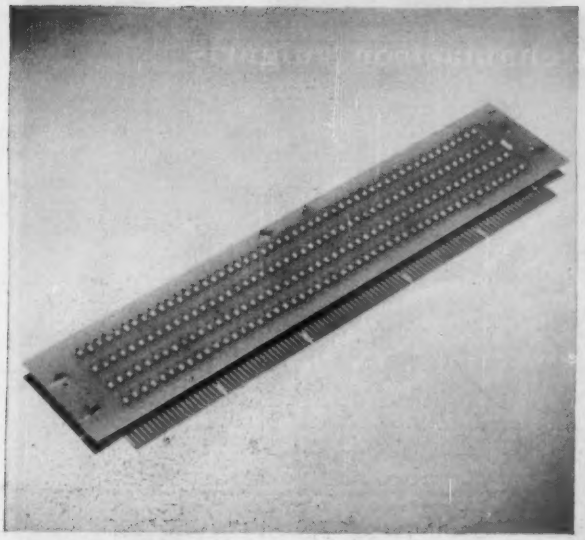

ALL COMPONENTS for Minuteman ballistic missile guidance and control system will be mounted in special trays (left), soldered in place, to largely eliminate handling of individual components and possible damage during repeated inspections and tests at component manufacturer's plant and at Autonetics, which will assemble system. Components will be checked every 8-10 days, using high-speed automatic tester (right), and each component's test history will be recorded on individual punched cards.

Reliability Is Essential Minuteman Goal

By Philip J. Klass

Downey, Calif.—One of the boldest and most comprehensive avionics reliability programs ever attempted, intended to improve present levels by a factor of 100, has been launched by North American's Autonetics Division for the guidance and flight control systems it will build for the Minuteman ballistic missile, WS-133A.

If the program achieves this goal, many of the innovations being pioneered by Autonetics and its component suppliers are likely to spread to other avionics manufacturers for important weapon system programs.

The success of the entire Minuteman concept of solid-propellant missiles left unattended for months or years in underground silos, yet ready for launch upon a moment's notice with a high probability of successful target kill, depends in large part upon the success of this Autonetics program.

Although reliability always is an important objective in any weapon system, for Minuteman it is an overriding objective and requirement. For the guidance and control equipment which Autonetics is designing, there are two aspects to reliability, according to Jesse Bowman, WS-133A project manager:

• **In-the-hole reliability:** the missile and its avionic equipment will enjoy a moderate, controlled environment but must survive extended periods of inactivity and repeated checkout testing without degradation or failure.

• **In-flight reliability:** after launch, the missile and its avionic equipment must withstand high shock, vibration and temperature for several minutes and each of the tens of thousands of individual components must perform without failure for a high percentage of the missiles launched.

The in-the-hole reliability achieved will determine the maintenance cost of supporting the Minuteman program. The in-flight reliability will determine the number of missiles required to perform the strategic mission. Both are important from an economic as well as a tactical standpoint.

MINUTEMAN component trays will be shipped in special containers designed to protect them against dust, shock and moisture. Punched card test records for each component are included in package.

For the Minuteman program, Autonetics has expanded the customary in-house reliability program beyond its own doors, deep into the research and manufacturing operations of more than a dozen component manufacturers that have been carefully selected to work with Autonetics on the WS-133A program.

Component Handling

One example of the type of innovation being tried on this program is in the area of component handling, shipping and test. In conventional practice, a resistor, capacitor or transistor is picked up, handled, laid down (and sometimes dropped) dozens of times before it eventually comes to rest on a printed circuit board.

There is outgoing inspection and test at the component maker's plant, preparations for shipment, followed by incoming inspection, test and handling at the equipment maker's plant. Each instance of handling offers the possibility of damage—which may not show up until some later time. It also increases over-all material handling costs.

Components destined for Minuteman guidance and control will not be handled individually from the time they are tested at the component maker's

DECEPTION IS A FORM OF COUNTERMEASURE

and at this the chameleon must be considered an expert.

The approach to the problem of survival through countermeasures has been neatly solved by this handsome little fellow. By simply changing his color to match the surroundings the chameleon may take on the appearance of a brown twig, a green leaf or so completely blend into the immediate area that his enemy is hopelessly confused. This, in effect, is countermeasure in the truest sense.

To confuse or mislead the enemy is often the problem faced by the military. Not to be outdone by the chameleon, electronic countermeasures have been developed which effectively confuse the presentations as seen on radar scopes. Defensive action is thereby delayed until too late. In this field, as well as many other forms of countermeasures, Instruments for Industry can apply exacting know-how and skill. The high degree of success achieved by IFI is proof of ability.

Only one target is a true target.
The big question . . . which one?

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plant until they are placed in the final printed circuit board at the Autonetics plant. Yet they will have undergone many more inspection and test operations than components normally used in military avionics equipment.

This will be accomplished through use of special component trays which resemble a printed circuit module with sandwich-type construction. Each tray will accommodate 200 identical components.

Before components are placed in the tray at the manufacturer's plant, they will have their leads cut and bent to the precise dimensions and form required later for placement on the printed circuit boards at Autonetics. Leads from the components protrude through holes in the two plates of the tray. The bottom plate has etched connectors, like a conventional printed circuit board, which run to pins of a male connector along the length of the bottom plate.

After the tray is filled with components, the bottom plate is dip soldered, connecting the component leads to the connector. The tray then is inserted in an automatic checkout equipment, built by Autonetics, for final test. The tray then is shipped to Autonetics in a specially designed package which protects the components from shock and moisture.

When received here, the components remain in the trays for inspection and subsequent testing. When components finally are ready for use, the tray's lower plate is passed through a hot solder bath, allowing it to drop off and free the component leads.

For the first time since the components were mounted in the tray at the component maker's plant, they are lifted out manually and installed in the Minuteman printed circuit boards.

Assembly Environment

This operation will take place in an air conditioned, humidity-controlled room where the employes wear nylon smocks and gloves. Assembly tables will be covered with a rubber mat to protect components that might accidently be dropped. If a component is dropped from an excessive height (to be established by test), the component will not be used, according to Dr. William J. West, chief of Autonetics' reliability engineering.

After final assembly is completed, the Minuteman system will undergo a full-

Radio Telescope to Study Sun's Corona

Stationary radio telescope, being constructed by Convair Division of General Dynamics Corp. near Clark Lake in southern California, will be used to learn more about intense radio signal it first detected several months ago which appears to come from outer fringe of sun's corona. When completed, radio telescope will consist of a rectangular grid of 256 dipoles of copper wire, suspended from four-by-four posts in eight parallel rows extending for two miles in an east-west direction, about 800 ft. in a north-south direction. Telescope is designed for operation at frequency of 26.3 mc., has a resolution of about ½ deg. in east-west direction. Telescope normally looks straight up, but it can be tilted up to 45 deg. off the vertical to scan portions of the sky by relatively simple change in branching feeder system of wires that interconnect elements of the network. Project is headed by Dr. William C. Erickson, radio astronomer for Convair Scientific Research Laboratory.

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SERIAL BINARY (LINEAR)	707	7 bits (128)	128
	713	13 bits (8192)	128
	717	17 bits (131,072)	128
	719	19 bits (524,288)	128
SERIAL BINARY (SIN-COS)	757†	7 bits per quadrant* (4 quadrants)	512
	758†	8 bits per quadrant* (4 quadrants)	1024
BINARY CODED DECIMAL (8-4-2-1)	723	2,000	200
	724	20,000	200
	733	3,600	200
	734	36,000	200
	735	360,000	200
GRAY	708	8 bits (256)	256

◉ All models available with internally mounted isolation diodes for sequential multiplexing applications.

†Available in hermetically sealed servo-driven package as Models 757-S and 758-S.

*Including limit 1 and polarity information. Sine and cosine functions generated simultaneously and independently. One turn of shaft generates 4 quadrants of information.

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NEW SONAR SIGNAL PROCESSOR DOES WORK OF 1,000 UNITS

The first sonar signal processors to utilize time compression are being produced by General Electric. These new processors were developed in cooperation with the United States Navy. Extracting only critical bits of transmitted and received signals in series, one unit can perform as many correlating operations on a continuous signal—in the same time—as a parallel processor with thousands of units.

Excellent improvement in signal-to-noise ratio also makes these new processors effective against background levels which have formerly made certain signals undetectable by any other practical means. The new equipment is also designed to handle signals from more than one transducer.

This advance in sonar signal processing is typical of General Electric's many achievements in defense electronics. 227-3

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operational "burn-in" period of testing, ranging from 250 to 1,000 hr.

The component trays not only provide a convenient transport for the devices, but also expedite the considerable testing which they must undergo. Each component is given a serial number prior to shipment from the manufacturer's plant, which it carries for life.

During final test at the component maker's plant, the key performance characteristics of each component are recorded on its own serial-numbered punched card.

The same shipping container that brings the component tray to Autonetics carries the corresponding punched cards. At North American, the component trays are again checked with an automatic tester, identical to the one at the component maker's plant. Complete tray of 200 components can be tested in two minutes. Results of tests are recorded on each component's punched card, alongside earlier measurements.

'Active Storage'

The component trays are then placed in "active storage," where they have partial power applied to each of the components. After approximately 8 to 10 days the trays are withdrawn and tested again, then returned to active storage. This will continue for about three months (2,100 hr.), after which the components receive their final performance check.

Those which have failed, or whose final values do not fall within acceptable limits, will be rejected. Equally important, those components whose test histories reveal a change of characteristics sufficient to cause them to shift outside allowable limits within the next several years will also be rejected. This ability to forecast deterioration sufficient to cause system failure at some future date is extremely important for a missile like the Minuteman.

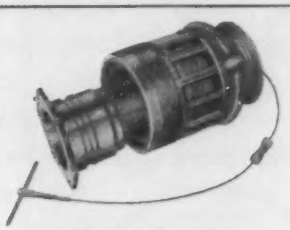
Additional Tests

About 20% of the components that pass will be withdrawn for additional tests. Of this number, about 75% will undergo another 4,000 hr. of life tests to establish the component's pattern of wear-out. The remainder will undergo destructive tests in an environment severe enough to greatly accelerate failure and thereby disclose the most susceptible failure mode.

Recognizing that quality and reliability must be built into the components and cannot be tested into them, North American plans to "impound" every component that fails anywhere—in the component maker's factory, at Autonetics, or in the field—and examine it to determine the basic cause of failure, according to Dr. West.

Each of the Autonetics component

Roylyn products



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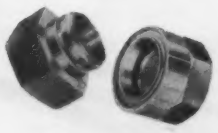
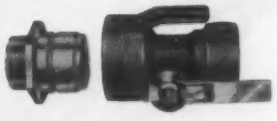


OPEN COUPLINGS

TUBE UNIONS



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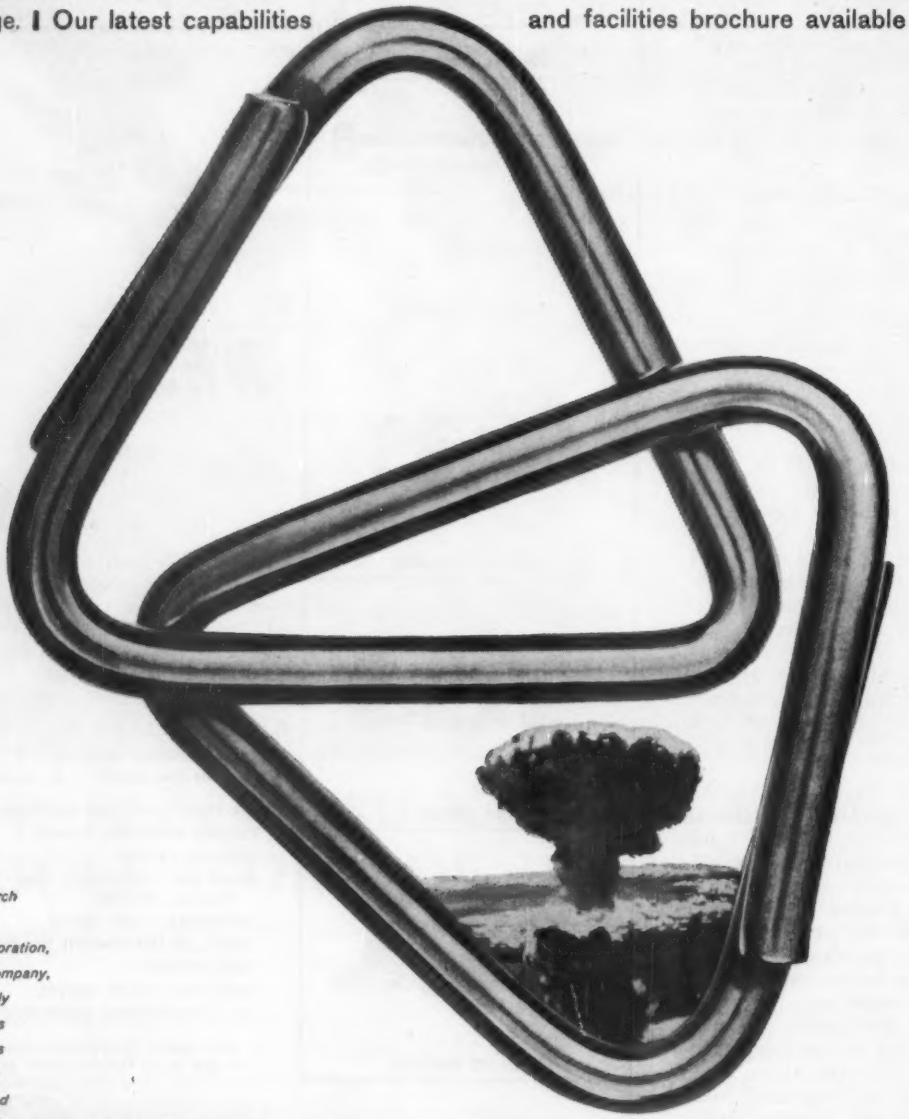

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suppliers will set up facilities to determine the basic cause of every component failure and to work out new materials or processes for eliminating each mode of failure.

Nearly all of the component manufacturers also are setting up either a separate production line or a separate facility for manufacturing the ultra-reliable components that are demanded by Minuteman.

Product Improvement

Autonetics carefully tested the products of many suppliers, as well as surveying their facilities, before selecting its approved sources. Despite the existing high quality of their products, Autonetics and the manufacturers already have planned a three-phase product improvement program. In the first phase, the manufacturer will incorporate all known methods and techniques for improving intrinsic product quality and reliability of the existing device.

After this has been done, a large sample will be subjected to accelerated life tests to determine how much improvement has been achieved. Components will be operated at higher-than-normal temperatures, power ratings, voltages and shock-vibration.

Unless such severe environments are employed, it might take years of testing to produce sufficient failures to give a representative sample of all possible failure modes.

As laboratory analysis of failed components, both from accelerated life tests and from normal use conditions, discloses new failure modes and new fixes, they will be incorporated in a subsequent phase of the product improvement program. The resulting product will then be compared with its predecessor by means of new life tests.

Statistical Sampling

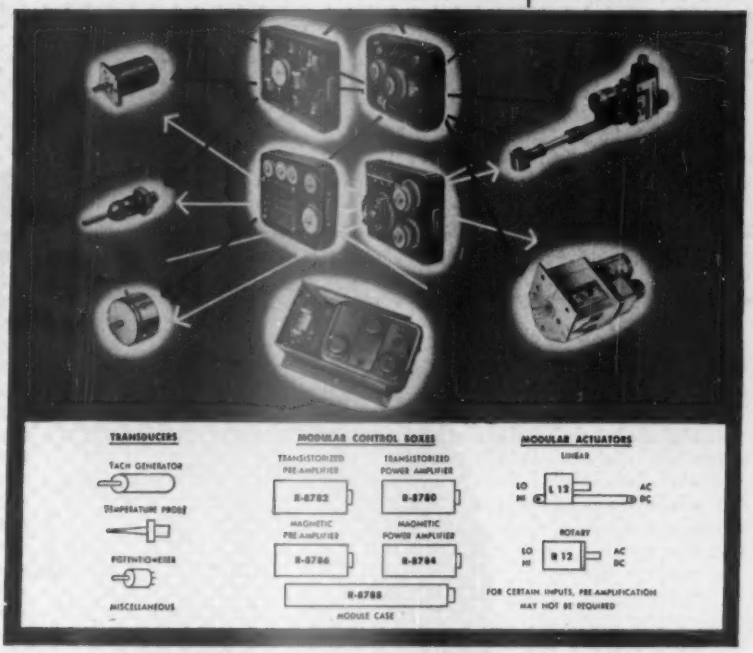
In addition to the tests designed to evaluate intrinsic quality of the component design, the manufacturer also will carry out extensive statistical sampling procedures to assure that each batch of components produced meets minimum standards. These process control tests will be performed on components at various stages of manufacture, as well as on the completed units prior to shipment.

To monitor the extensive testing program at component supplier facilities and provide technical liaison, Autonetics plans to station its own engineers at each of the component manufacturer's plants.

Recognizing that reliable components do not in themselves assure a reliable end equipment unless the components are properly applied, Autonetics has set up an extensive in-house reliability program for the WS-133A, headed by Ray-

Now—Modular Control Systems

New Airborne concept saves design time, helps you get faster delivery



Heart of Airborne's new modular control systems is a contactorless control package consisting of a standardized case (3 x 3½ x 5 in.) into which packaged preamplifier and power amplifier subsystems are plugged. Amplifiers drive actuators having maximum operating loads up to 500 lb. (linear) or 100 in.-lb. (rotary). Modular design permits delivery of relatively complex systems in minimum time.

Over the past 6 years, Airborne has designed and produced a number of special electromechanical control systems for aircraft-missile use. While these have differed in their functions, many of them have nevertheless employed essentially similar components. Thus our policy has been to seek increasing standardization of parts through modular design—to the point where we can now offer complete systems engineered under this concept.

From transducer through actuator, these new Airborne systems are assembled entirely from standardized, interchangeable components. For many applications, you can design around these packaged systems as they stand—and thus reduce engineering time, lead time, and costs. In other instances, slight modifications of the modular units provide the basis for immediately available systems.

Get complete information on this latest Airborne development by requesting new Bulletin PS-5A. If you feel your requirements are unique and cannot be met with standardized units—however flexible—we still invite your inquiry. As mentioned, Airborne offers an extensive background in custom systems—for temperature control, servo control, and positioning.

See Airborne's new modular control systems at the Aircraft Electrical Show in Los Angeles

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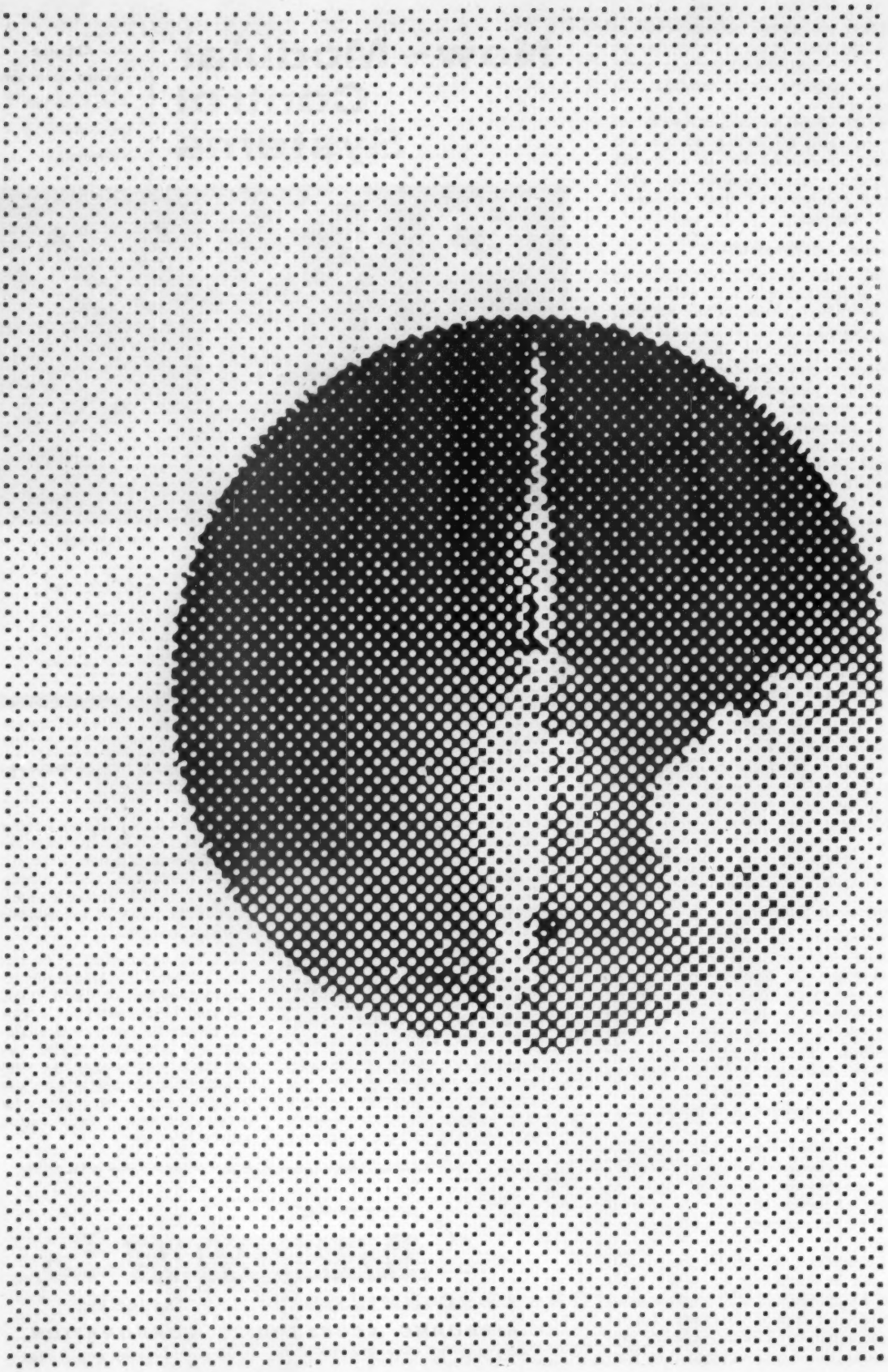


There are 7,500 dots shown here.
This is the number of engineers in the eight divisions of Martin. And 40 percent of these—the 3,000 dots in the circle—are electronics/electrical engineers.
It is this specialized capability that enables Martin to develop electronic systems which anticipate the exacting demands of the missile-space age.
Example: A Martin electronic system known as Master Operations Control (MOC) has been a vital factor in the exceptional performance of TITAN. By automatically checking the hundreds of systems necessary to successful flight, MOC has removed much of the human error from complicated countdown procedures.

The eight divisions of The Martin Company are Activation, Baltimore, Cocoa, Denver, Nuclear, Orlando, RIAS, and Space Flight.

mond Racine, who reports to Dr. West. The Autonetics reliability engineering department employs about 130 persons of which nearly 80 are professionals, according to Dr. West.

One of the first steps was to establish specific quantitative reliability objectives, measured in mean-time-to-failure, for the over-all guidance and control system, then to break it down into corresponding figures for each subsystem, for each black box, each circuit, and finally for each component.

Failure Rate

Having done this, the next step was to establish what failure rate can be expected from each of the components selected for use. This requires extensive component testing, under a variety of environmental and use conditions, to establish the relationship between failure rate and component environment and application. For example, what increase in component reliability can be obtained by derating its power level by 25%, or by 50%?

In designing Minuteman guidance and control system circuits, Autonetics engineers must consider not only sudden-death type component failures, but also the gradual shift in component characteristics that can cause sufficient deterioration in over-all system performance to result in mission failure.

Each circuit is analyzed to determine how much design margin exists for every component. That is, how much shift in component value will cause system performance to drop below a minimum acceptable value. This is done by preparing d.c. and a.c. equivalent circuits for each circuit, then writing the equations which define conditions which constitute effective circuit failure.

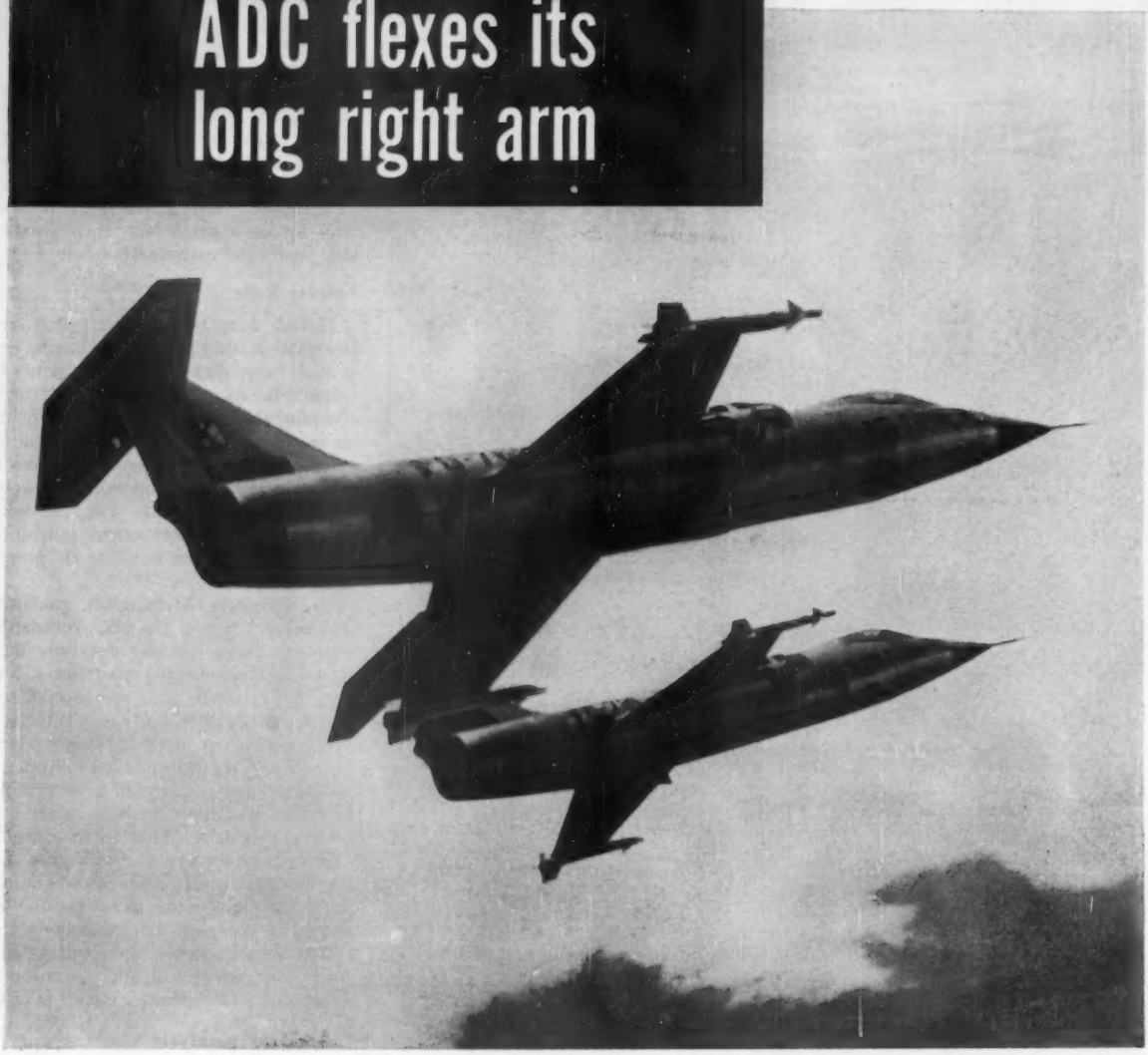
Computer Analysis

Using this as a criteria, each circuit is then analyzed by an IBM 709 computer, which can vary the value of one or more components and calculate how much additional shift of value by the component under study will cause circuit failure. The computer analysis is checked by means of breadboard circuits and the results of both plotted in a "Schmoo Chart."

These give a designer a quick picture of how much shift in each component value will cause circuit failure. Comparing this with data obtained from life test histories of actual component value shift serves to pinpoint the critical components. The designer then can modify a basic circuit to make it less vulnerable to shift of that component value.

Because the over-all reliability of a system is the product of the reliabilities of its individual parts, Autonetics also has a major program to minimize the number of components used in its cir-

ADC flexes its long right arm



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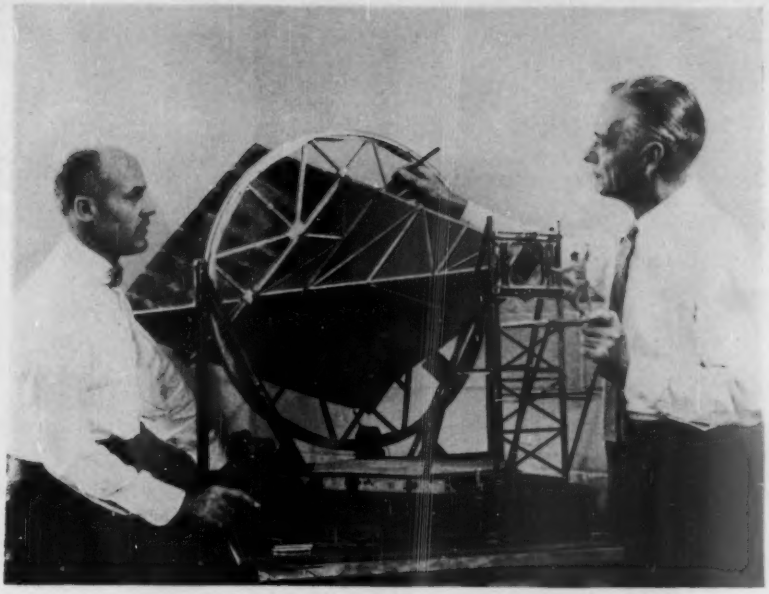

Antenna for Satellite Communication Tests

Model of the experimental horn antenna to be used in joint Bell Telephone Laboratories and NASA satellite communications tests is examined by Bell engineers. Because of the large commercial potential of wideband microwave communications by passive satellite relay, Bell is reportedly supporting with company funds about four-fifths of the cost of the program. The ground station being constructed by Bell at Holmdel, N. J., will consist of a conventional parabolic antenna for transmitting and the horn antenna (above) for receiving, plus equipment for determining position of satellites in orbit and tracking data for the antennas. The horn antenna will measure about 50 ft. in length with an aperture about 20 ft. square, and will include either a parametric amplifier or Maser for the first stage. One of the projects in the program will be communication between Holmdel and NASA's Goldstone tracking station operated by the Jet Propulsion Laboratory, about 2,300 mi. apart, probably employing the earth's natural satellite, the moon, for passive relay.

cuits. A related program aims to reduce the number of different types of components used in the Minuteman in order to concentrate the reliability product improvement effort on as few components as possible. Dr. West estimates that the WS-133A will use only about one-third as many different types of components as equivalent guidance and control systems for other missiles.

Autonetics officials estimate that approximately 25% to 30% of the cost of the North American Minuteman development program represents clearly identifiable reliability effort, within Autonetics and its major suppliers. If this produces even a tenfold improvement in over-all missile reliability, it will be a net economic gain by reducing the number of missiles and costly underground launching sites which must be constructed to assure a given number of successful missions.

The Autonetics Minuteman program is under the executive management of the Air Force Ballistic Missile Division, with Space Technology Laboratories holding responsibility for systems engineering and technical direction.

Expansions, Changes In Avionics Industry

Recently announced changes, expansions and mergers in the avionics field include the following:

- **Atlantic Research Corp.**, Alexandria, Va., has acquired **Jansky & Bailey**, communications consulting engineering and electronics firm in Washington, D. C., and a 16% interest in General Communication Co. of Boston which earlier had acquired Jansky & Bailey. Atlantic Research Corp. is engaged in solid propellant rocket development. No change of personnel is planned.
- **Telemeter Magnetics, Inc.**, Los Angeles, has acquired **Invar Electronics Corp.**, Pasadena, Calif. New subsidiary produces solid-state power supplies and electronic instruments.
- **Artloom Industries, Inc.** has acquired **Eastern Precision Resistor Corp.**, Brooklyn, N. Y.
- **Textron Electronics, Inc.** has acquired **Globe Electronics**, Council Bluffs, Iowa, producer of radio transmitting and receiving equipment in a stock exchange arrangement.

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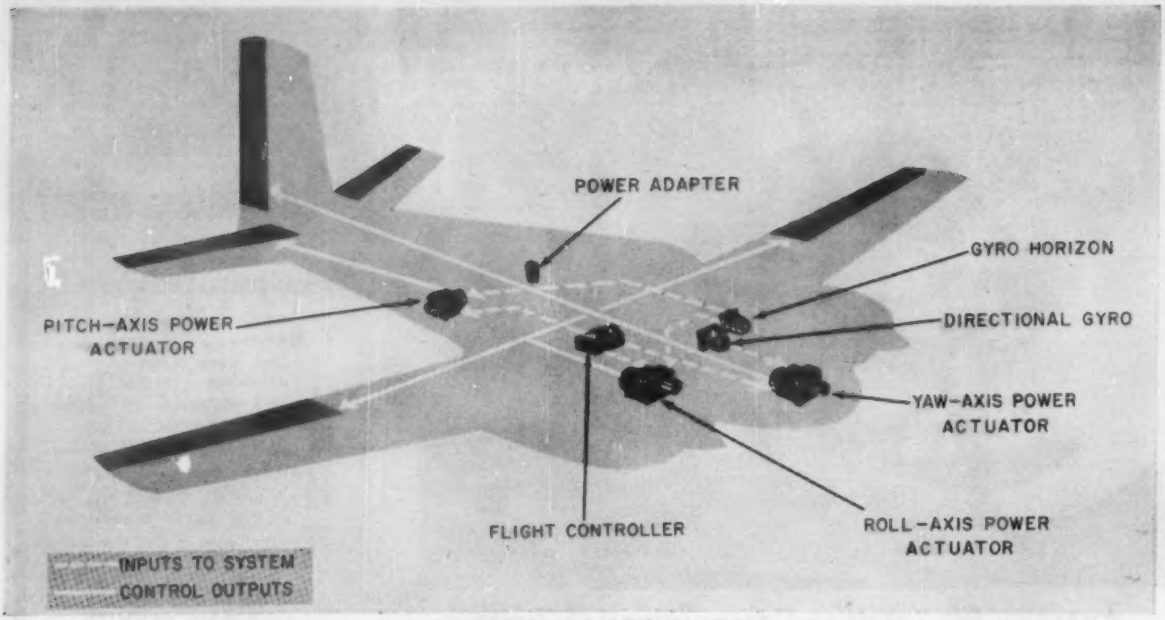


SPERRY SP-3 three-axis autopilot system is depicted as it would be installed in a light twin-engine aircraft. The use of combination computer-actuator units permits the system to be expanded from a single-axis autopilot by the addition of the desired roll, pitch or law axis computer-actuator. Torque output of the 5 lb. actuators is up to 125 in. lb.

Sperry Develops Lightplane Autopilot

Fully transistorized three-axis autopilot for single and small twin-engine aircraft (AW Sept. 28, p. 23), which weighs 27 lb. and costs only $4,000, including gyro instruments, marks Sperry Rand's entry into the lightplane autopilot field. The company has long been a producer of autopilots for military and large commercial aircraft.

The new Sperry SP-3 employs a building-block design that makes it possible to start out with a single-axis installation for approximately $1,500, adding additional axes of stabilization at a later date. The SP-3 also includes provisions for automatic ILS approach, omnirange beam riding and constant altitude control as optional accessories which will become available next year. The autopilot can handle aircraft sizes ranging up through the Beechcraft 18 series, the company says.

COCKPIT CONTROLLER of the SP-3 autopilot is shown as it might be installed in the Cessna 182 Skylane, single-engine aircraft. Buttons at the base of the control unit are for optional approach and navigation couplers.

Simplified Installation

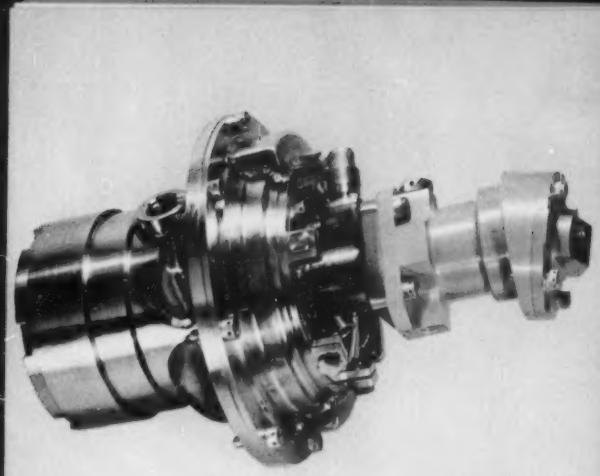
The system is designed to minimize installation cost and facilitate system check-out and maintenance by combining the autopilot amplifier and servo actuator in a single package. A complete three-axis installation consists of two air-driven panel instrument gyros, three "computer-actuators," a cockpit flight controller that enables the pilot to introduce maneuvers through the autopilot and to select the mode of operation and a small power adapter for converting an aircraft's d.c. power to the required a.c. and to stabilize voltage.

The fully transistorized SP-3 autopilot consumes one ampere per axis, or a total of three amperes for the three-axis configuration, under normal flight conditions.

In turbulent air, or with one engine out power consumption may double or triple these figures.

In its first public demonstration aboard a Piper Apache (light twin) flown by Sperry's Henry Warren, the aircraft

FROM TAPCO...
Secondary Power Systems
FOR MISSILES AND
AIRCRAFT



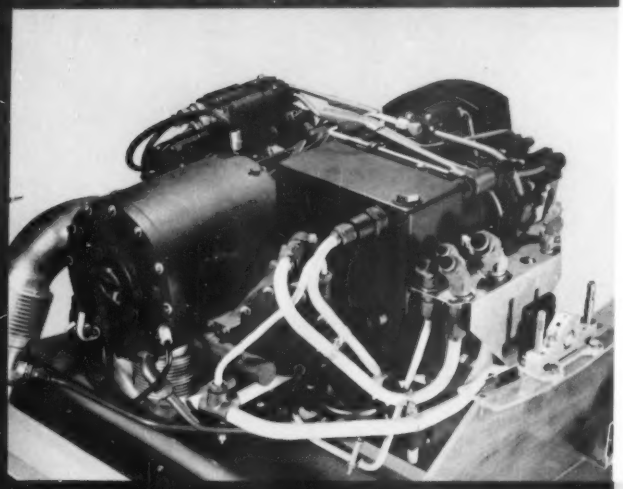
New TAPCO-developed UNIPUMP is a solid-fuel, self-regulating, single-shaft turbo-hydraulic supply. Capacities from 1 to 5 gpm at 3000 psi for durations up to 3 minutes.

FROM TAPCO...

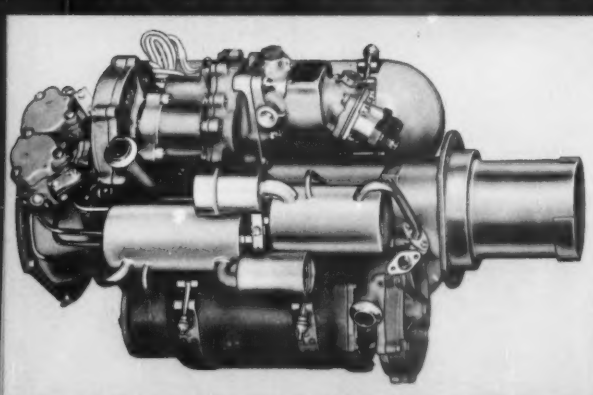
Secondary Power Systems using any energy source for any power output

Here you see a few of the secondary power systems developed and built by TAPCO for leading missile and aircraft manufacturers. These systems provide power for flight control and generate electrical energy with precisely-controlled frequencies as low as ±.001%.

Some TAPCO secondary power systems operate in high-temperature ambients. Others operate in the cryogenic range. Our half-century of experience in producing precision components to function reliably in abnormal ambients is especially important in

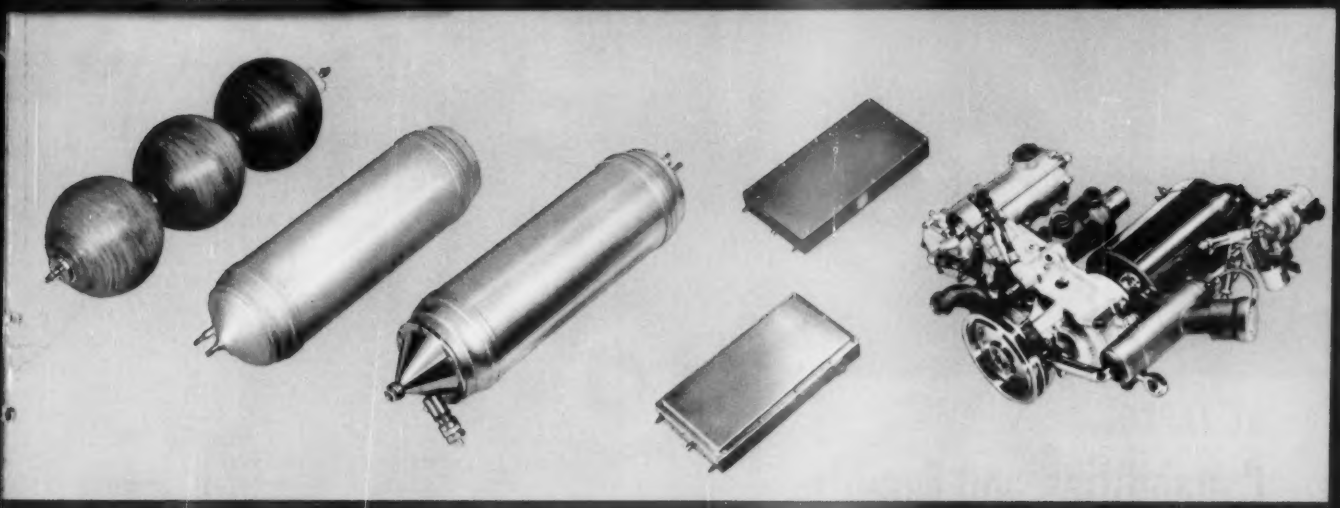


This TAPCO Auxiliary Power Unit, driven by a 4-stage solid-fueled turbine, produces 70 HP to generate 40 kva. of electricity and to drive a hydraulic pump for actuating controls.



Liquid fuel self-contained electrical and hydraulic power supply designed and developed by TAPCO. Solid fuel versions of these auxiliary power supply units are being used in Terrier missiles.

MINIAPS, a new TAPCO developed solid fuel miniature turbo generator, provides up to 200 watts of power. This multiple output concept supplies precise voltages and frequencies, in both AC and DC current for missile, fuzing and telemetering applications.



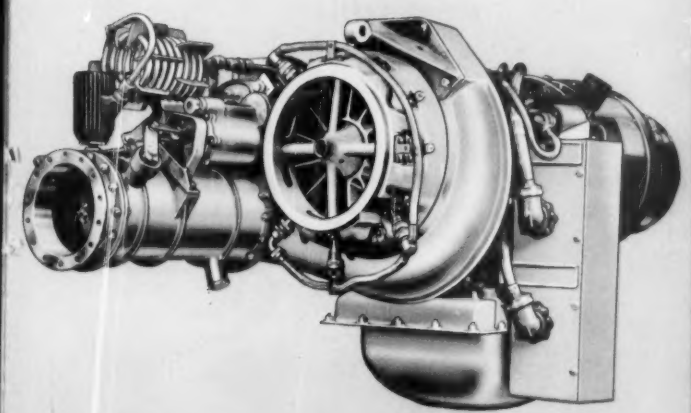
Auxiliary power unit designed by TAPCO to provide all electrical and actuation power for the advanced Bomarc missile. This is a completely self-contained package system which requires only a start signal to provide power for the missile during flight. It meets unusually difficult environmental conditions.

present-day and future applications. Also, our experience with metals and materials to resist the effects of corrosive liquids and gases is vital in producing turbines and power system components that are in contact with unusual combustion conditions resulting from liquid and solid propellent gas generators.

Some secondary power applications more economically use bleed or ram air as an energy source. TAPCO's broad background in the development of air turbines is valuable in applications of this type.

Years of experience in developing all types of pneumatic, electronic and mechanical controls is still another part of TAPCO's secondary power system capability. This includes rotating electrical machinery and electronic and electrical speed controls with transistorized components.

Advanced research is now underway at TAPCO to determine the secondary power systems of the future. This activity includes the investigation of such new energy sources as fuel cells, solar power and nuclear power.



Air-driven turbine and 60-kva alternator with TAPCO-designed controls that hold 400-cycle current to ±¼% stability in compounded operation.

TRW

TAPCO GROUP

Thompson Ramo Wooldridge Inc.

CLEVELAND 17, OHIO

DESIGNERS AND MANUFACTURERS OF SYSTEMS, SUBSYSTEMS AND COMPONENTS FOR THE AIRCRAFT, MISSILE, ORDNANCE, ELECTRONIC, AND NUCLEAR INDUSTRIES

In the TAPCO main research and test center shown here, all types of operating conditions can be simulated... high altitudes, elevated and cryogenic temperatures, high-speed rotation, hot-liquid and solid-fuel feeds, and multiple-G. Twelve other TAPCO research and test labs throughout the country augment this laboratory.

AT TAPCO...

Capabilities and Facilities to develop any Secondary Power System

For designing and developing secondary power systems for new applications, the TAPCO Group includes stress analysts, ceramicists and metallurgists, combustion engineers, computer programmers, and a score of other talents. A new project or idea can be staffed promptly with experts from the 1250-man TAPCO engineering group.

Available to these people are complete research, development, and test facilities, with equipment ranging from a 240-circuit, 80-channel analog computer to a high-altitude environmental test chamber.

In addition, when very unusual projects require it, the research people and facilities from the TRW staff and the 11 other TRW divisions can be called on.

More than 3-million square feet of TAPCO manufacturing facilities, equipped with every type of modern precision machine tool, are available to deliver your secondary power system on-schedule.

Three TAPCO testing facilities can test any secondary power system under simulated or actual operating conditions. This assures you of ready-to-go units proved to meet your requirements.

Let us work with you and your staff on your next requirement for a secondary power system of any type. Write to:

Complete facilities and manpower are available in the TAPCO Group for simulation, certification and pre-delivery testing of equipment built by TAPCO.

TAPCO's 1100-acre Roanoke Test Facility can run tests involving high-G, very-high temperatures, supersonic sound, high-amplitude vibration, high-radiation, shock, and high- altitude conditions in any combination. Shown below are some of the environmental test buildings, with Rucker Centrifuge pit to handle sustained acceleration from 0 to 60 G's and package sizes up to 600 lbs.

TAPCO GROUP

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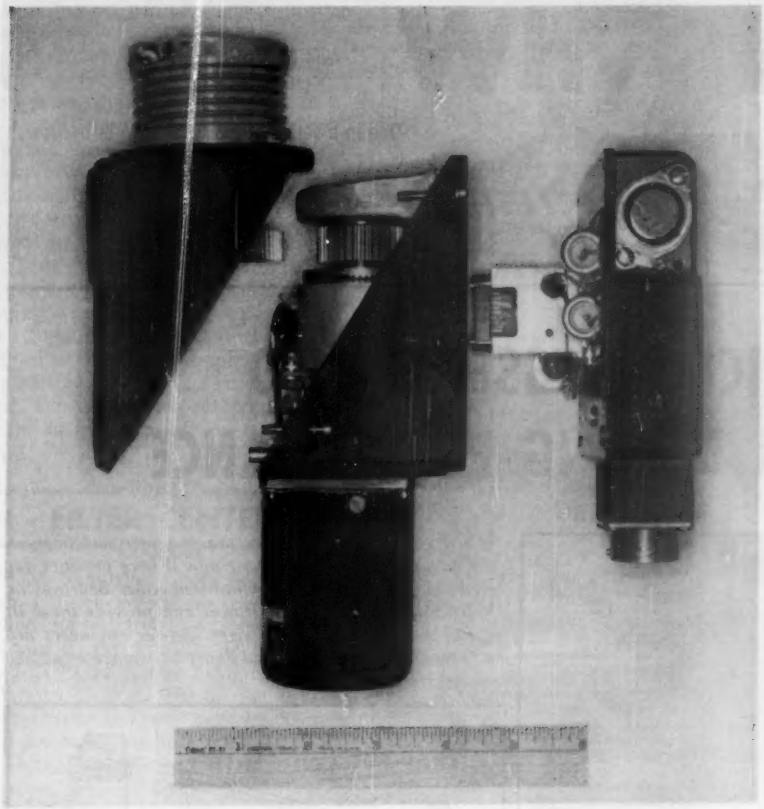


EXPLODED VIEW of the computer-actuator unit shows the transistorized servo amplifier (right) which is calibrated for a particular aircraft type, the gear drive and clutch assembly (center), and the drum and bracket unit.

was placed on autopilot during climbout from Teterboro, N. J. airport and remained an autopilot throughout the 30 min. flight until Warren turned base for landing.

The small flight controller was located between the pilot and copilot seats within easy reach of both. Controller contains an on-off switch, left-right turn knob and aileron and elevator trim knobs. A selector switch also is provided to select operating mode when altitude control and approach coupler are installed. An electrical interlock prevents the autopilot from being engaged unless power is available, the gyros are uncaged and the turn knob is centered.

Weather Marginal

Weather during the demonstration flight was marginal VFR and a controlled departure was flown to a clear area over the Tappan Zee section of the Hudson River. There, Warren demonstrated the autopilot in turns, climbs and glides, both in cruise and landing configuration, with asymmetric power to simulate single engine operation.

The SP-3 maintained heading and preset flight conditions during all maneuvers, including when the aircraft was badly out of trim. With one engine throttled back to simulate engine failure, the Sperry autopilot maintained heading without manual trim correction. In general performance, the autopilot appeared comparable to large aircraft systems, except that nose-up trim must be dialed manually during a turn to prevent loss of altitude. With the automatic altitude hold option, this would not be necessary. Maximum bank angle in the demonstrator was 45 deg., but this will be reduced to 30 deg. in production model.

A separate autopilot disconnect button can be mounted on the wheel to provide instant disengagement of the actuator by means of solenoid-operated clutches. Although clutches are fail-safe design (disengage in event of loss of power), pilot can manually overpower the actuators in an emergency.

To provide heading, bank and pitch signals for the autopilot, Sperry has modified its standard air-driven panel-mounted directional and attitude gyros to incorporate small electrical pickoffs. The gyros are military surplus units, one reason for the low price tag on the SP-3. (Lear also uses military surplus units in its L-2 lightplane autopilot.) If the aircraft already carries air-driven gyros, the additional weight of the autopilot actuators amounts to only 18 lb. for the full three-axis system.

Computer-Actuator Design

Design of the computer-actuators reflects awareness of the need for easy maintenance and repair. The transistorized amplifier portion can be removed as a unit for repair or replacement, as can the motor, without disturbing the airplane's cable rigging. Torque output of up to 125 in.-lb. is available from actuator, depending upon the internal gear train.

Computer-actuator contains a built-in reference signal that can be used to check its operation, requiring only

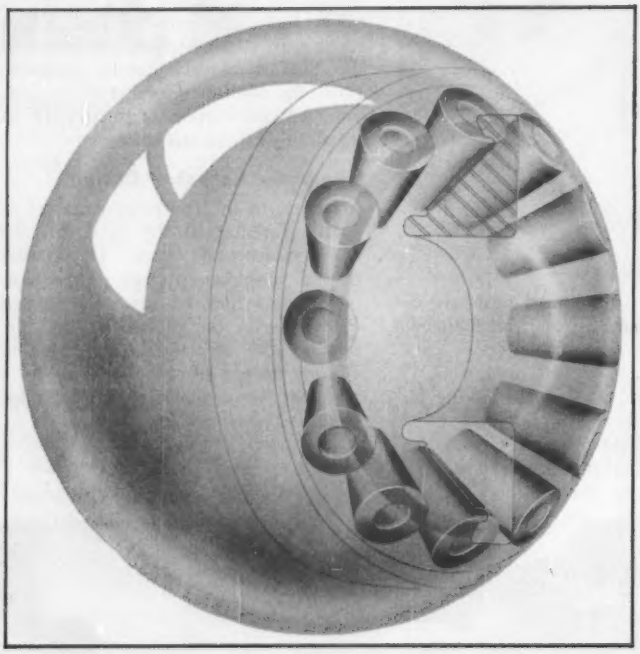
USAF Pilots Receive Weather Briefing on TV

Jet aircraft pilot at Suffolk County AFB, Riverhead, N. Y., receives weather information on closed circuit television before flight. System, developed by General Electric's Communication Products Department, connects weather station with pilots gathered before monitors or receivers.

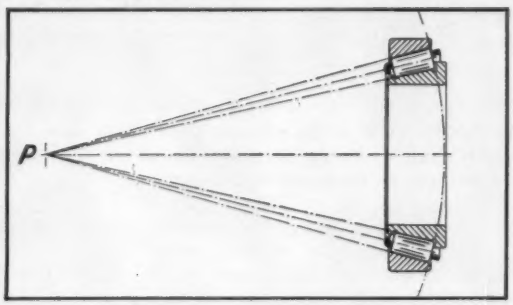
One in a series of technical reports by Bower

BEARING BRIEFINGS

SPHERICITY — ESSENTIAL TO MAXIMUM BEARING PERFORMANCE



When you require bearings, we suggest you consider the advantages of Bower bearings. Where product design calls for tapered or cylindrical roller bearings or journal roller assemblies, Bower can provide them in a full range of types and sizes. Bower engineers are always available, should you desire assistance or advice on bearing applications.



True rolling of tapered bearing elements depends upon maintaining a true spherical radius during manufacture.

For a tapered roller bearing to achieve maximum performance, i.e., maximum life and capacity under load, it must have true sphericity — a condition of bearing geometry which permits true rolling of the tapered rollers in the raceway.

True rolling in tapered bearing elements is the result of maintaining a critical geometric relationship between the raceways and the contact surfaces of each roller. True rolling is essential to maximum performance. Without it, premature bearing failure is certain.

As engineers know, a tapered roller will describe a true circle when rolled on a plane surface. *It will always roll in this one path precisely, without sliding or skewing.* But to put true rolling to work in a bearing which can carry both heavy thrust and radial loads, it is essential that the rollers *and* the raceway have a true spherical radius, or sphericity. The drawing illustrates this condition.

If each roller in the bearing were to be extended in length, while retaining its taper, it would form a cone, terminating at point "P". All cones generated from all rollers would meet at point "P", which is also the center of the hypothetical sphere shown. The surface of the sphere would *touch all points on each roller's head!*

In effect, then, each roller's taper determines the radius of a hypothetical sphere whose surface, in turn, determines the correct contour for each roller head. Only when these conditions are satisfied in design, and when they are rigidly held during manufacture, will true rolling take place. In the manufacture of each Bower tapered roller bearing, sphericity is held within extremely narrow limits by means of special Bower-designed precision grinders. The consistent accuracy possible with these machines is one major reason why Bower roller bearings provide maximum performance under all speeds and loads up to the bearing's maximum rating.

BOWER ROLLER BEARINGS

BOWER ROLLER BEARING DIVISION — FEDERAL-MOGUL-BOWER BEARINGS, INC., DETROIT 14, MICHIGAN

several jumper wires for complete computer-actuator checkout. Reference signal should produce prescribed movement of the output drum, otherwise unit is inoperative.

The SP-3 was developed by Sperry Phoenix Co., a division of Sperry Rand. Sperry Phoenix recently announced a lightweight "universal" autopilot developed for use in a variety of Army lightplanes and helicopters.

Sperry plans to distribute its new autopilot through aircraft manufacturers and their dealers. The first models will go to lightplane producers this fall to determine computer-amplifier design parameters required for each aircraft type. First production autopilots are expected to go to aircraft owners early in 1960.

FILTER CENTER

▶ **ECM Simulator Competition**—More than a dozen companies are expected to bid for electronic countermeasures operator trainer-simulator for the AN/ALQ-27 ECM system being developed by Sperry Gyro for use on the B-52H. Competition is being held by Sperry. The device reportedly is designed to be the most sophisticated ECM trainer-simulator yet developed.

▶ **Infrared Look-Out for A3J**—Navy's new A3J attack plane under development by North American Aviation, Inc., will be outfitted with an infrared surveillance system intended to warn the pilot whenever he is under attack by an interceptor or missile. System is being developed for North American by Radio Corp. of America's Missile Electronics and Controls Dept.

▶ **Microwave Peak Power Measurement**—New device which can directly measure and visually indicate peak power of pulse radars to an accuracy within 0.5 db. by non-calorimetric methods has been developed by General Communication Co. Presently available Model PCS-1A covers frequency range of 925 to 1,225 mc., and can handle power levels of −10 to +63 dbm. Company's address: 677 Beacon St., Boston.

▶ **Reliability Record**—Burroughs digital computers used with General Electric radar for guidance of initial Atlas ballistic missile squadrons have racked up a reliability performance figure of 0.998 in operations on a 24 hr., seven day a week basis, the company says. It adds that its computers "never have been responsible for a delayed or an abortive launch."

▶ **Calling All Authors**—The 1960 Electronic Components Conference, May 10-12, Washington, D. C., has issued

Why does USAFE

equip its airfields with

BEFAB SAFELAND OVERRUN BARRIERS

?

F-100D No. 56-3233 of the USAFE engaged at Toul Rosieres AB, France

To give highest degree of safety to the pilots!

These barriers, which are put up at the ends of the airport runways, are designed to stop jet airplanes (from 4000 up to 300,000 lbs. gross weight, also commercial aircraft) which for one reason or another overshoot the runways. The main object of the Safeland Barrier is to protect the flying personnel from being injured owing to unsuccessful starts or landings.

The Safeland Barriers are, since some years ago, in service at many military airports throughout the world. Aircraft saved in many distress situations and the many governments reordering this reliable safety device shows the extreme capability.

- Stabilizes aircraft entering webbing asymmetrically, e.g. when skidding or ground looping.
- Causes little or no damage to aircraft.
- Additional safety in cases of pilot fatigue or other reasons.
- Simple rigging and easy to move if necessary.
- Low purchase, installation and maintenance costs.

Ordered by e.g. Australia, Denmark, Finland, France, Gt. Britain, Holland, Indonesia, Iran, Italy, Norway, Pakistan, Sweden Switzerland and the USAFE. Some governments have already reordered Safeland Barriers.

Other products represented or manufactured:

Certain electronic equipment, refuelers, super-sound ear protectors, anti-g suits, nylon and other synthetic fibre ropes for marine use, etc.

BEFAB • BORGS FABRIKS AB • NORRKOPING • SWEDEN

4 Electronics Leaders Will Help Mold This Astronautics Division

If ever an organization was designed from the start for space systems development and production, this one is.

Formed last August, *Chance Vought's Astronautics Division* already has made first deliveries on a NASA contract to provide *Scout* research vehicles.

For the future, four major lines of interest have been chosen: development of more *Scout*-type research vehicles; research payloads, including reconnaissance and astronomical satellites; manned space vehicles, and long-range studies to anticipate future needs.

This is a self-sufficient, self-managing division. *A few key posts are being filled now with men who can both mold the organization and direct its space programs.* Four such men are needed to fill these astrionics positions:

1. ***Senior Specialist for Navigation and Guidance Group.*** Advanced E.E., Ph.D. preferred. Experience in stellar navigation and star tracking systems techniques and in RF guidance and inertial navigation systems. To organize this area of divisional activity, handle conceptual design.

2. ***Senior Specialist for Communications and Detection Group.*** M.S.E.E. preferred, familiar with space communication systems, antenna systems and wave propagation in fields of radio frequency, microwave, ultraviolet and infrared systems. To develop and lead this area of divisional activity.

3. ***Astrionics Staff Scientist.*** Ph.D. preferred. To conduct advance theoretical analysis and apply advance technology in navigation and guidance, communication and detection, and automatic controls.

4. ***Guidance Systems Engineer.*** Physics or E.E. (M.S. preferred). Experience required with stellar guidance systems for space applications and with analytical and equipment systems. To conduct guidance analysis.

To inquire in complete confidence, write:

J. R. Clark, General Manager,
Astronautics Division
Dept. M-36

CHANCE VOUGHT
DALLAS, TEXAS

a call for technical papers. Subject matter can range from molectronics to magneto-optics, from thermoplasticity to electroluminescence, or less glamorous components. Abstracts of 150-200 words should be submitted in triplicate by Dec. 15 to: Gilbert B. Devey, Sprague Electric Co., North Adams, Mass.

► **Pinpoint Guidance**—New automatic airborne guidance system named Pinpoint, which combines inertial and radar map-matching techniques, developed by Goodyear Aircraft Co., is now undergoing Defense Department evaluation, the company reports. Goodyear developed the radar map-matching guidance system, known as Atran, used on some versions of the Martin Mace surface-to-surface missile.

► **Melpar,** a subsidiary of Westinghouse Air Brake Co., will establish a research and development subsidiary for its parent company in Florence, Italy. New operation will be known as Ricerca Scientifica Applicata, S.P.A., or RSA for short. Director of company will be Prof. Guiliamo Toraldo di Francia, professor of optics and microwaves at University of Florence, who will head technical activities. Managing director will be Prof. Renato Galli, who heads economics department at University of Florence. Thomas Meloy, president of Melpar, will be chairman of the board of the new Italian subsidiary. Melpar also announces the formation of a new Physical Sciences Laboratory at its main plant in Falls Church, Va.

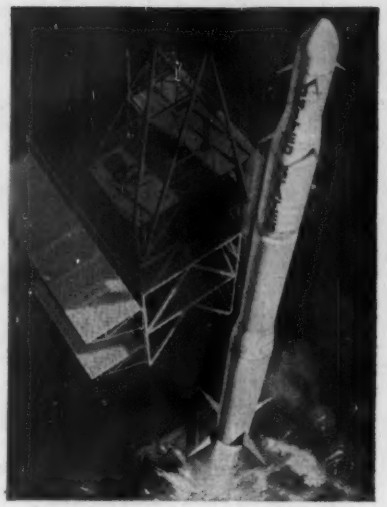
► **Perkin-Elmer Corp.,** Norwalk, Conn., electronic-optical systems producer, will open a 15,000 sq. ft. research and development facility at Los Angeles.

► **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers includes:

• **Continental Electrics** Manufacturing Co., subsidiary of Ling-Altec Electronics, Inc., has received a $5.3 million contract from General Electric for additional super-power radar transmitters to be used at Ballistic Missile Early Warning System installation at Clear, Alaska. Earlier contract for $10.9 million covered production of transmitters for BMEWS site near Thule, Greenland.

• **Raytheon** has received $38.9 million contract from Sperry Gyroscope Co. for search and doppler radars to be used in the bombing-navigation system which Sperry is building for the B-58.

• **Packard-Bell Electronics Corp.,** Los Angeles, has received second contract from Navy Bureau of Aeronautics, for $1.25 million, for production of AN/APX-7 airborne radar recognition (IFF) sets.



VOUGHT BROADENS SPACE STUDIES

The *Scout*-type research rocket is a primary interest at Chance Vought, where this company's Astronautics Division is investigating the space-science as well as the military potential of such a vehicle.

Potential missions include boosting weather, commercial or military communications stations into space.

Astronautics Division concept studies of a passive electronics satellite and a reconnaissance satellite are producing additional valuable data in new and challenging areas.

Manned payloads for space are another major objective. Vought's work includes the man-carrying portion of the vehicle, and long-range studies aimed at training for space flight.

In specializing on crew quarters for space, this company draws on unequaled experience in human factors design for high-performance aircraft. As a member of the Boeing *Dyna-Soar* development team, Vought already has found this experience applicable to space.

Toward training for space flight, Vought has designed an orbital flight simulator. In a realistically furnished cockpit, using a new family of controls and instruments, the space trainee can "maneuver" into orbit and back to earth. More than 200 such "flights" have been made to date.

Space is the specialty of Chance Vought's Astronautics Division. Other major interests are being aggressively advanced in the Aeronautics Division — where attention is on atmospheric missiles, antisubmarine apparatus and piloted aircraft — and in the company's Electronics, Range Systems and Research Divisions.

CHANCE VOUGHT
DALLAS, TEXAS

NASA'S SCOUT WILL MARK A TRAIL FOR MAN TO FOLLOW

Scout is designed to explore paths into space . . . at low cost. The inexpensive, 70-foot research rocket will go after vital space measurements that require sounding after sounding. National Aeronautics and Space Administration scientists will use the vehicle to launch the satellites and probes that measure the ionosphere, map magnetic fields and gauge radiation. Chance Vought's job is to assemble *Scout's* four stages, build its airframe and launching tower – holding to low cost and high reliability standards. *Scout* will make many of the hundreds of space soundings NASA already has scheduled. From this rocket's well-blazed trail, scientists may unlock secrets that will pave the way for extended manned space flights.

AERONAUTICS | ASTRONAUTICS | ELECTRONICS | GENESYS CORP. | RANGE SYSTEMS | RESEARCH

CHANCE VOUGHT
DALLAS, TEXAS

DOMED PAVILION at First International Trade Fair at Brno, Czechoslovakia, houses aircraft accessories.

Czechs Seek Broader Aircraft Market

By Edith Walford

Brno, Czechoslovakia—Czech aircraft industry is aiming at a bigger share of the potential markets of the west in addition to its ready-made outlet for products within the Soviet bloc.

Major reason is Czech dependence on imports of raw materials from the west to meet the increasing rate of production laid down in its second five-year plan "for the development of the people's economy." The country also requires numerous consumer goods from abroad to supplement domestic supplies.

This was the view of Czech technicians at the First International Trade Fair here where Czechoslovakia demonstrated the products of its 40-year-old aircraft industry.

There were no new models among the range of sport and business flying machines on display. Emphasis was on more refined and powerful versions of well-established types. Russia is the biggest customer for these with Red China second in the list of 45 different countries to which Czechoslovakia has sold its light aircraft in recent years.

Socialist Coordination

Omnipol Foreign Trade Corp., Prague, sales organization responsible to the government for all foreign trade in light aircraft and related products, was in charge of the aircraft section of the fair. Omnipol's publicity manager, A. Kachlik, an engineer, pointed out that socialist countries are not interested in competing among themselves. They find it more profitable to coordinate production in every industrial field, he said, so that no two countries within the Soviet bloc manufacture the same type of goods.

The Czechoslovakian aircraft industry relies on Russia for supplies of big civil airliners like the Tu-104 and military aircraft and itself concentrates on the production of lightplanes for training, agricultural, sport and business flying purposes.

Contrary to this statement, Czechoslovakia is known to have produced the Russia MiG fighter series under license and, as Swiss observers say, offered them to the Swiss Flugwaffe about two years ago as a replacement for Switzerland's aging military aircraft.

Between 1955 and the first six months of this year, exports of Czech lightplanes and accessories have increased tenfold, Kachlik added, but no precise figures were available to substatiate this claim.

One exception to the all-Czech design and production of light aircraft is the Avia 14-32 A transport powered by two Ash-82T 1,900 hp. engines. A large fleet of these is in use with Czech Airlines.

The original 18-seat version based on the Russian Ilyushin I1-14 design was built under license in Czechoslovakia and later modified to accommodate 32

passengers. Only slight internal changes are now required to adapt it to either a 36- or 40-seat version for short routes and Omnipol says this is the next step planned for the further development and utilization of this model which is widely used in most Soviet bloc countries. Chief customers of the Czech-improved version so far have been Russia, China, Indonesia and Bulgaria.

A cargo version, the Avia-14T, is also available. The two-part, enlarged door for loading can be opened in flight making the plane suitable for parachute practice or for topographical survey. The interior accommodates all the photographic equipment required including complete darkroom. This is an essential requirement in countries like Russia and China where aerial survey work is carried out over vast stretches of isolated territory beyond easy reach of such ground facilities. Additional uses of the Avia-14T are as an ambulance, for patrol or fire service over large forest areas and for transport of heavy cargo, particularly of prefabricated parts for buildings.

Aero 145

The Aero 145, an improved model of the Super Aero twin-engine, four-seat touring and multi-purpose lightplane, was also demonstrated at the Brno Fair. In appearance it is very similar to its predecessor. It is powered by two M 332 140 hp. Walter Minor engines with direct fuel injection instead of the two 4-III 105 hp. engines of the same series which power the Super Aero type. The Aero 145 can be used as an air taxi, for service flights, as an ambulance, for training and sport purposes, geological research and photographic mapping.

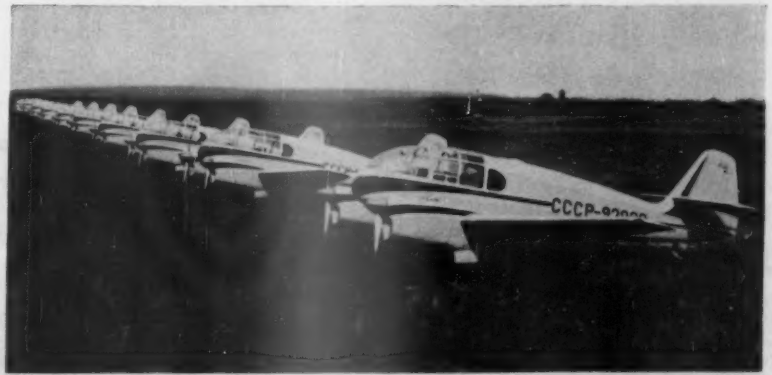
So far, Super Aeros have been sold to 25 different countries, but Russia, which to date has purchased a total of 230 for service with Aeroflot, remains its biggest customer. It has gained great popularity as a feeder aircraft to the big airports in the Ukraine. On the Black Sea it is used for taking foreign tourists on sightseeing trips and, because of its landing and takeoff characteristics on grass strips, it is being employed increasingly in the Caucasus where there are few concrete runways.

Ceskoslovenske Aerolinie, the national airline, is using a fleet of Super Aero planes for its taxi service connecting the industrial centers of the country, particularly as a very frequent shuttle service between Prague and the second largest town in Czechoslovakia, Brno. It is probably the first service of this kind to be established on such a large scale in Europe. Postwar economic conditions in Czechoslovakia made it necessary for administrators to keep in close touch with industry. This led to the introduction of the Super Aero taxi service which is becoming more and

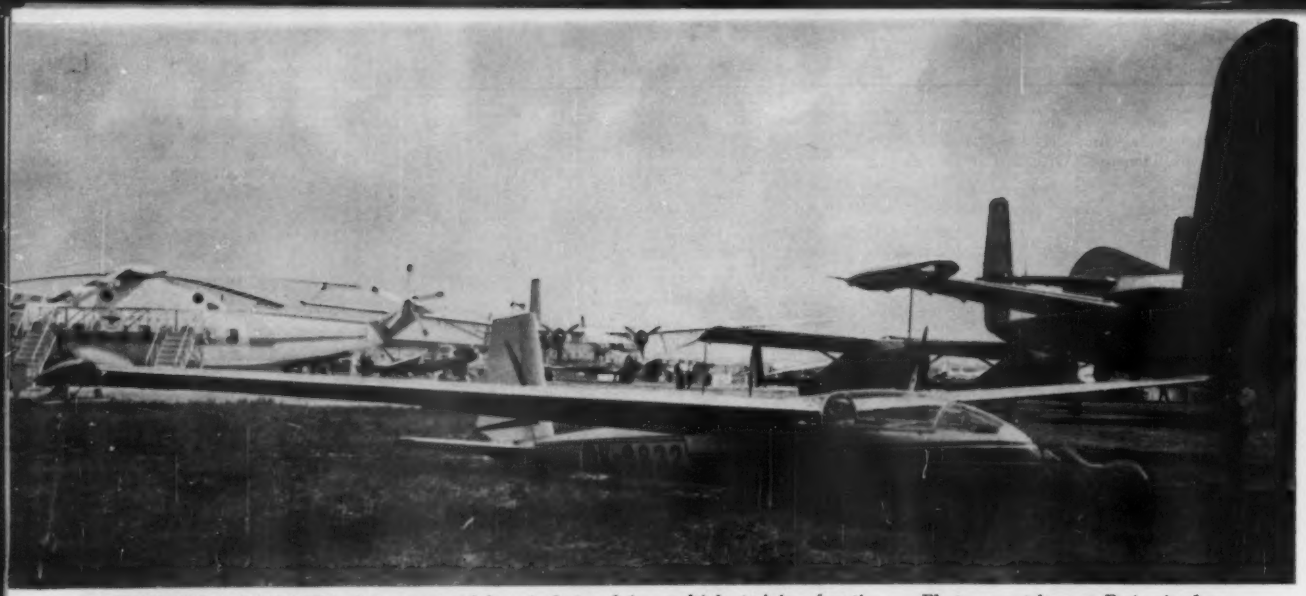
Z 326 Trener Master two-seat all-metal lightplane has Walter Minor 6-III engine.

MORAVA transport and air taxi is built in either a four- or five-seat configuration.

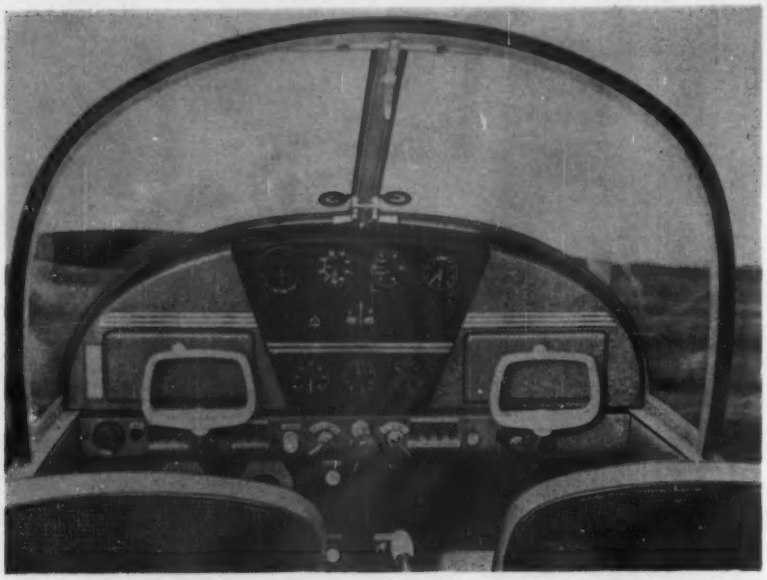
BRIGADYR L 60 high-wing, four-seat utility aircraft is shown in agricultural version.



SUPER AERO four-seat touring and multi-purpose planes are ready for delivery to Russia.



CZECHOSLOVAKIA'S L-13 Blanik two-seat sailplane is designed for multiple training functions. Photo was taken at Paris air show.



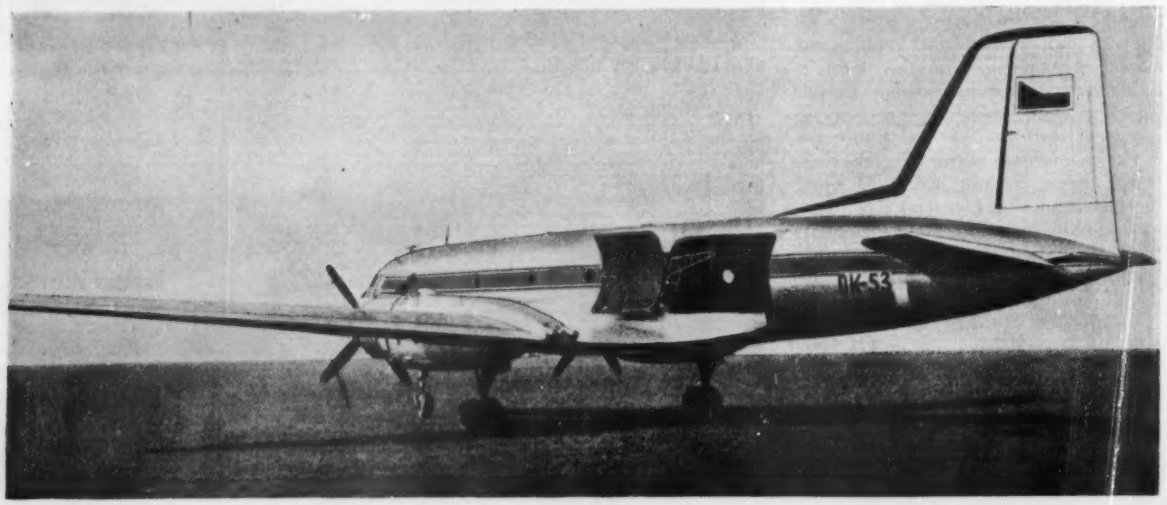
META-SOKOL L 40 cockpit is shown above; Avia 14-32 A cargo version is below. The transport is powered by two Ash-82T 1,900 hp. engines. This design is based on the Soviet Il-14.

more economical with its steadily increasing popularity. At present rates it works out at about 15 to 20% more expensive than cab fares.

Other models on show and flown in demonstration flights were:

• **L 200 Morava** small transport and air taxi plane. It is produced in two versions, as a four- to five-seat transport or as an ambulance capable of carrying two patients on stretchers in addition to the pilot and a doctor. It is powered by two M 337 type engines rated at 210 hp. each. Omnipol says this aircraft will probably be supplied in quantity to Russia which, earlier this year, bought a few for testing purposes. Compared with similar Russian types such as the Antonov An-14 Bee, the Russians chose the Morava as the better of the two aircraft.

• **Z 326 Trener Master,** a two-seater tandem, low-wing, all-metal airplane derived from its predecessor, the Z 226 Trener Master. Powerplant is a single Walter Minor 6-III inverted, air-cooled engine. Structural and functional modi-



BOOK NEWS-NOTES

AS THE PRO FLIES

Here are techniques that will help you to fly expertly, in a professional manner. Taking off, approaches and landings, using compass and maps, and other basic skills are clearly described, along with new flying aids, night flying, jet flying, flight check, etc. Emphasis is on "Quality X"—the ability to think fast, plan ahead for safer, more enjoyable flying. **By John R. Hoyt, 272 pp., 80 illus., $4.95**

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L 60 Data

Dimensions	
Span	45.8 ft.
Length	28 ft.
Height	8.9 ft.
Track	9.8 ft.
Weights	
Empty weight including agricultural equipment	2,183 lb.
Load (fuel, crew and usable equipment)	992 lb. to 1,212 lb.
Gross weight	3,168 lb. to 3,410 lb.
Wing loading	11.96 psf.
Power loading	14.1 lb./hp.
Performance	
Maximum sea level speed	120 mph.
Continuous cruising speed	110 mph.
Minimum speed with flaps full down	32 mph.
Minimum glide speed	46.6 mph.
Service ceiling	14,750 ft.
Takeoff run	295 ft.
Takeoff distance over 50-ft. obstacle	738 ft.
Range at 75% maximum power	448 mi.
Fuel consumption at cruising speed	10.56 gal.

fications and a retractable landing gear have made this type suitable for both elementary and advanced training and for aerobatics.

• **L 40 Meta-Sokol** all-metal, low-wing, four-seat monoplane designed for sports flying and touring. It is powered by a single Walter Minor M 332 140 hp. engine with fuel injection and supercharger.

• **L 60 Brigadyr** high-wing, four-seat, utility aircraft suitable for a wide variety of duties such as transport of passengers and cargo, agricultural work, ambulance and for military operations. Powerplant is a single Praga Doris M-208B internal combustion, flat-six, air-cooled engine rated at 220 hp. at 3,000 rpm. Omnipol explained that the agricultural version was developed specifically to save labor in the wide areas of the "cooperative farms."

• **HC-2 Heli-Baby** two-seat, light, general-purpose helicopter powered by a flat-four Praga DH engine developing 83 hp. at 3,000 rpm. This model was first introduced in 1956 and followed in 1957 by a more powerful version (130 hp.), the HC-102. Only a few of these were produced for research purposes. A further development of this helicopter is now under construction, but Omnipol said no details are available until the first models are ready for demonstration.

• **L-13 Blanik** tandem, two-seat sailplane designed for all categories of training from elementary to blind flying and for high performance flight. The all-metal fuselage is of semi-monocoque

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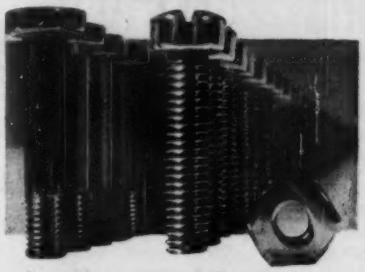

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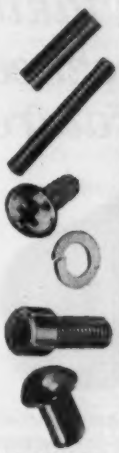

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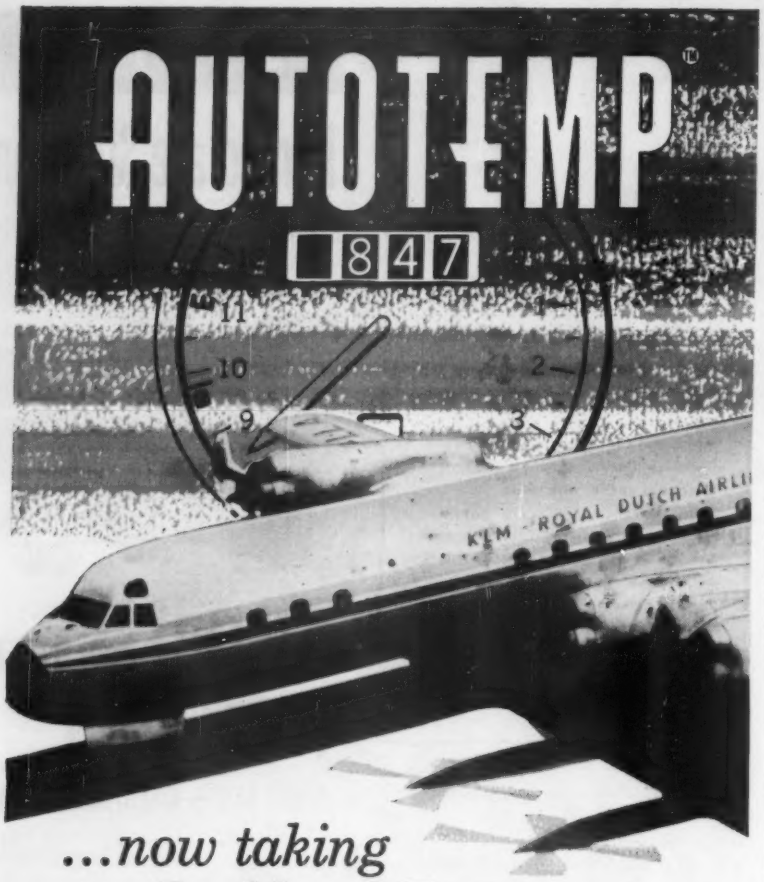

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Full information is contained in our Bulletin BH183 available for the asking!

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Super Aero Data

Performance	
Maximum speed	165 mph.
Cruising speed	145 mph.
Range	993 stat. mi.
Service ceiling on two engines	16,600 ft.
Ceiling on one engine	4,420 ft.
Takeoff run	241 yd.
Takeoff distance over 50-ft. obstacle	492 yd.
Landing run	301 yd.
Fuel consumption	10.5 gph.
Dimensions	
Span	40.4 ft.
Length	24.8 ft.
Height	7.3 ft.
Wing area	184 sq. ft.
Track	9.6 ft.
Weights for range of 600 mi.	
Empty weight (equipped)	2,120 lb.
Total usable load	1,190 lb.
Gross weight	3,310 lb.
Wing loading	17.93 psf.
Power loading at nominal power	15.7 lb./hp.

structure and the plastic glass canopy of the nose section can be ejected in case of emergency. The Blanik is now in production; the first 100 to be produced will go to Russia.

Orders Received

Omnipol said business at the fair was very satisfactory and substantial orders for the Morava, Super Aero and Trener Master 326 for delivery by 1961 had been received from several east European countries. It was difficult to quote prices of the different aircraft, Kachlik explained, since they varied according to the purchaser, but he added that in general Czech light aircraft could be produced and sold cheaper than comparable aircraft of foreign make.

This year's First International Trade Fair at Brno is closely linked with the traditional engineering exhibitions held at Brno on a national basis from 1955 to 1957. Prewar, Czechoslovakia displayed its engineering products every year at the Prague Sample Fair, discontinued when the country was occupied during World War II.

Fair's Purpose

Purpose of this year's international fair was to help further trade and economic relations between countries with different social systems, to enable direct exchange of technical experience and to foster international cooperation and friendship between nations.

About 160,000 people visited the fair daily, so that by the time it closed, more than two million persons had passed through the gates.

Primarily, the fair featured machine tools, raw materials and semi-finished

He took Bomarc off in a crosswind

This AMF engineer's design problem: a launcher to hold the bird on its pad in a 60-mile gale, let go on firing, *not* let go on misfiring.

His solution: Four aluminum arms, each a stubby 3-feet long, that clasp 40-foot Bomarc around its tail. Unlike systems that release during countdown, whether or not the bird goes, this system releases only on a positive, upward movement that actuates a valve in the pad. But, because all mechanical devices can fail, an emergency release system was also needed...

So, he put a small lever at the end of each arm. This lever makes actual contact with the bird. As Bomarc moves up, these levers rotate with it. After an inch of movement, they automatically snap the arms out of the way if the basic system has not already done so. Even in a wind that causes violent lateral movement, Bomarc won't get bumped. Simple, sure...imaginative.

Single Command Concept

AMF brings ingenuity like this to every assignment. AMF people are organized in a *single operational unit* offering a wide range of engineering and production capabilities. Its purpose: to accept assignments at any stage from concept through development, production, and service training...and to complete them faster...in

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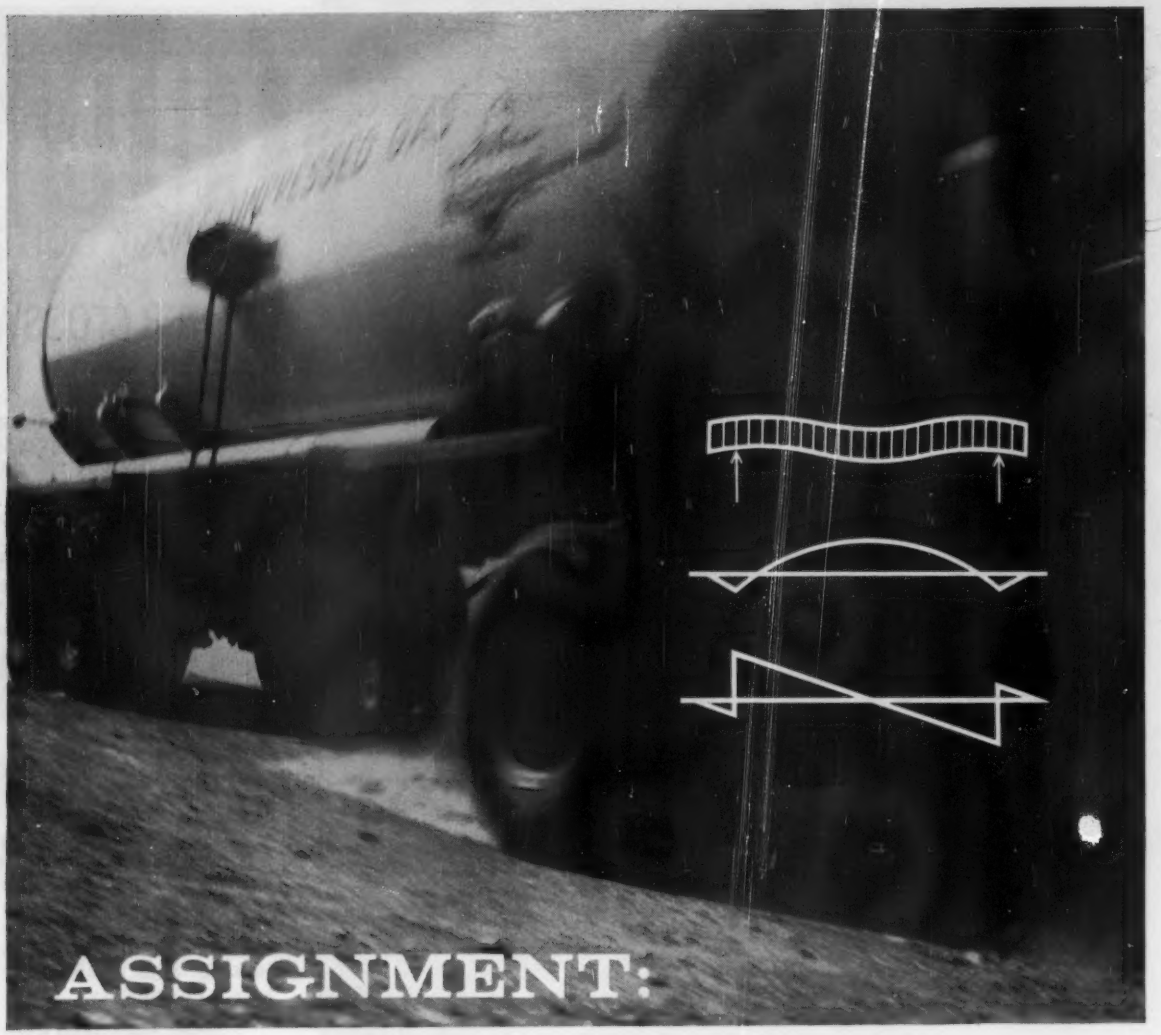

STRENGTH / WEIGHT

How Lukens *Application Research* can help you find the right steel plate for the job

Designing for maximum payload means taking maximum advantage of today's high strength steels. Experts who know these steels—from a practical as well as technical standpoint—can give invaluable assistance in the early planning stages. This is the job of our Application Engineering staff.

LPG transport tanks and power shovels are widely divergent areas in which Lukens engineers have helped increase payloads.

The use of Lukens "T-1" steel plate and heads in tanks for hauling LP-Gas has fostered an entirely new design concept in the tank truck field. This high tensile, high yield strength steel (100,000 psi) makes it possible to mount wheels *directly on the tank.* The dead weight of heavy underframes goes into payload.

Working with a major producer of power shovels, our staff suggested tough Lukens "T-1" for buckets, dipper sticks, bucket teeth and other key parts. Lightweight, welded steel plate—rather than heavy castings—added as much as 40% to load capacity.

From these successful projects—and many more—our Application Engineers have gained knowledge and experience of value to design engineers. That's why we say... *if your assignment is strength/weight, let it be our assignment, too.* Contact Manager, Application Engineering, J-109 Services Building, Lukens Steel Company, Coatesville, Pa.

Helping Industry Choose Steels That Fit The Job

LUKENS

ASK FOR THE LUKENS "T-1" STEEL BULLETIN

Meta-Sokol Data

Powerplant	
M 332 with injection pump and supercharger	140 hp.
Dimensions	
Span	33 ft.
Length	24.5 ft.
Height	8.25 ft.
Wing area	156 sq. ft.
Weights	
Useful load	882 lb.
Empty weight	1,177 lb.
Gross weight	2,059 lb.
Wing loading	157 lb./sq. yd.
Power loading at nominal power	14.75 lb./hp.
Performance	
Maximum speed	147 mph.
Cruise speed	126.7 mph.
Landing speed with flaps	59 mph.
Takeoff run	869 ft.
Takeoff length over 50-ft. obstacle	1,312 ft.
Landing over 50-ft. obstacle	1,722 ft.
Fuel consumption	3.6 gal./100 mi.
Range	686.5 mi.

goods for the engineering and metallurgical industries.

Of the 31 different countries represented, nine including Czechoslovakia belonged to the Soviet bloc, 22 to the western group.

Aircraft Display

Aircraft were displayed outside the biggest—it covered 194,000 sq. ft.—and most handsome pavilion of the exhibition. There were 15 pavilions in all covering 700,000 sq. ft., twice the area taken up by the covered section of the former national engineering exhibitions. The open-air space was 645,000 sq. ft.

Aircraft engines, accessories, complete airport equipment and one fully equipped pilot training cabin, typical of those already delivered to East Germany and Poland for airline pilot training, were on show. The same pavilion was shared by Western Germany, Switzerland, Canada, the Netherlands, Italy, France, Great Britain, Argentina, Yugoslavia, Tunisia and India.

One of each of the aircraft displayed in the fair was also ready with pilot for demonstration flights at Brno Airport.

800th Aero Commander Delivered to Buyer

Aero Commander No. 800, a Model 680E, was delivered recently to Cherf Bros., Inc. and Sandkay Contractors, Inc., Euphrata, Wash. Delivery marked a production average of 100 airplanes annually since Aero Design was founded.

without E-W cooling units, electronic gear in this hut would burn out in minutes!

The Ellis and Watts Model A-9 Unit that keeps this critical electronic gear cool has a cooling capacity of 9000 BTU's per hour. Without this vital cooling capacity the electronic equipment would burn itself out in a matter of minutes! Wherever electronic gear is used, it creates heat problems. And, in compact airborne huts these problems are especially serious.

Designing and building specialized units to keep electronic gear cool is our business at Ellis and Watts. Units of any capacity, configuration, control requirements or functions can be designed and built to any applicable military or commercial specifications. E-W Units will function perfectly in any climate conditions on earth.

For additional information on Ellis and Watts Model A-9 Unit for cooling electronic gear in airborne huts or similar installations, write for Bulletin #130-A.

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HILLER 12E is 27.8 ft. long. Height to top of rotor is 9.8 ft. Service ceiling, at maximum gross of 2,700 lb., is 14,000 ft.

Aviation Week Pilot Report:

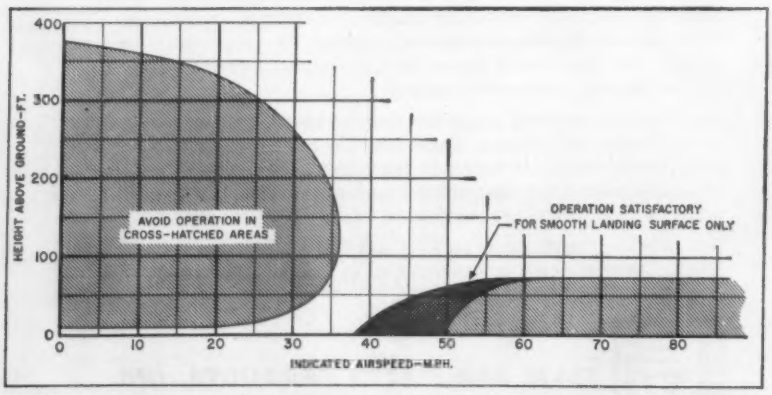
Hiller 12E Demonstrates Maneuverability

By Robert I. Stanfield

Power and agility of the light, three-place, Hiller 12E helicopter—which weighs 1,700 lb. empty and can carry a useful load of 1,000 lb.—were the most impressive features evidenced during an AVIATION WEEK flight evaluation.

The 12E, which grosses 2,700 lb., is powered by a Lycoming VO-540-B1A six-cylinder air-cooled engine rated at 310 hp. at 3,300 rpm. at sea level. For its class it is the nation's highest powered certificated (on Jan. 6, 1959) helicopter. The main rotor gear ratio is 8.66 to 1; the anti-torque rotor gear ratio is 1.44 to 1. Fuel grade is 80/87 octane.

Cost of the standard 12E is $59,950. The helicopter is produced at the Hiller Aircraft Corp. plant in Palo Alto, Calif. It utilizes the same basic airframe of the company's lower-powered military H-23D "Raven," which was first delivered to the U. S. Army in December, 1957.



HEIGHT-VELOCITY curve for safe autorotation landing of the 12E. Heights and airspeeds are determined for maximum weight, smooth surface, calm wind, sea level and 3,200 ft.

Service ceiling of the 12E, at maximum gross weight, is 14,000 ft. Rate of climb, grossing 2,700 lb., is specified as 1,400 fpm. Cruise speed, at 75% power, is 95 mph. indicated. In addition to its capabilities as a personnel and equipment carrier, the utility helicopter is used as a cargo carrier, for geodetic surveys, supply missions, fire fighting, spraying-dusting-fogging, patrol and as an aerial ambulance.

Basic Structure

The 12E sits low on its skid gear (including ground handling wheels), connected to two horizontal tapered spring tubes. Height from ground to cabin floor is 21 in., making for easy accessibility to cabin. The basic body structure is of semi-monocoque construction. The upper surface, in the area of the engine compartment, incorporates a stainless steel deck acting as a firewall. The tail boom is aluminum alloy, of similar construction.

The large, neatly furnished cabin embraces side-by-side seating for three. Cabin width, at seat, is 4.7 ft.; the maximum interior width is 4.9 ft. The bubble canopy affords good visibility in all directions. The cabin enclosure is a composite structure of aluminum alloy and transparent plastic sheet. The aft

bulkhead serves as the firewall.

Main rotor blades, each of which has a removable faired tip, are all-metal. The main forward spar is of torch silver brazed steel. Trailing edge skin, extrusion and channels are of aluminum and adhesive bonded to forward assembly. Blades are interchangeable, though adjustment for track and balance may be required at installation.

The main rotor hub is of forged aluminum alloy construction with steel inserts to support the rotor fork bearings. Blades are attached to the hub via a forged steel blade fork and tension-torsion bar.

Tail Rotor

Tail rotor, which also utilizes interchangeable blades, is constructed of aluminum skin with an internal leading edge doubler attached to a blade root fitting. Blade attaches to the hub by means of a laminated tension-torsion bar.

Helicopter also incorporates a fixed horizontal stabilizer, on starboard side adjacent to the tail rotor, to aid longitudinal stability. It is constructed of a steel tubular spar with aluminum alloy ribs and skin.

Engine and rotor mount consists of a tubular steel structure, attached to the fuselage by fittings, supporting a forged aluminum outer gimbal ring by unibal attachments fore and aft. An inner gimbal ring is flexibly attached to the outer gimbal through two lateral Lord mounts. The transmission bolts to the top of the inner gimbal ring and the engine bolts to the bottom of the inner gimbal ring, allowing transmission removal without disturbing the engine.

Bladder type fuel cell holds 46 gal. Fuel is moved to the engine by an engine driven pump. The system also includes an electric auxiliary pump. A fuel shut-off valve is located between the fuel tank and the firewall and is controlled from the cockpit.

Helicopter flown by AVIATION WEEK was EI-AKT, the first production 12E (company serial number 2001) earmarked for Irish Helicopters, the first commercial helicopter operation in Ireland. Demonstrator was powered by a Lycoming VO-540-A1A delivering 305 hp. at 3,200 rpm. Along with us, and demonstrating the rotorcraft abroad, was Robert M. Boughton, Hiller's export sales manager.

Instrument Panel

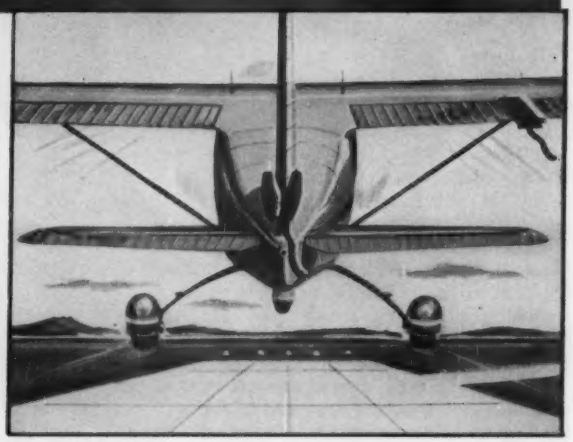
Main edge-lighted instrument panel is centered in the bubble-type nose, backward from which projects a small quadrant for the power levers. Setup is accessible from any position in the cockpit. The trim system is electrically controlled. The demonstrator, of course, was equipped with dual controls. The control sticks are chrome

TELESCOPING instrumentation and communication towers on 12E cargo racks (above) will extend to 100 ft. Helicopter can carry a useful load of 1,000 lb. Hydraulically operated rescue hoist (below), with 100 ft. of steel cable, has a load capacity of 250 lb.

ESSO

WING TIPS

COMPASS CAPERS. Metal objects such as pliers, earphones (particularly when on the head), cameras, etc., when positioned near your compass, can cause a deviation of many degrees. Also, prop de-icers, when turned on, can make it read up to 12° off.



POINT OF NO RETURN. Even experienced pilots have sometimes taken off with gust locks still firmly attached to ailerons, elevators and rudder. Avoid foolish mistakes like this. Always check your controls for full freedom of movement before taking off.

BLIND TAKE-OFF. Be careful of puddles on the runway. Water splashing onto the windshield can obscure vision completely. And in freezing weather the resulting ice may be difficult to remove.

REMEMBER! For "Happy Flying"... look for the famous ESSO Sign for the most dependable aviation products.

FLYING CHARGE ACCOUNT. Here's real convenience – get an Esso Aviation Credit Card from your Esso Aviation Dealer. When you land, your plane can be completely serviced without making any cash payment. With an Esso Credit Card, you can charge gasoline, oil, and lubricants *plus* tire and battery service, landing fees, overnight in-transit storage and minor repairs.

ESSO STANDARD OIL COMPANY

Highways or Skyways..."ESSO RESEARCH works wonders with oil"

Hiller 12E Estimated Operating Costs

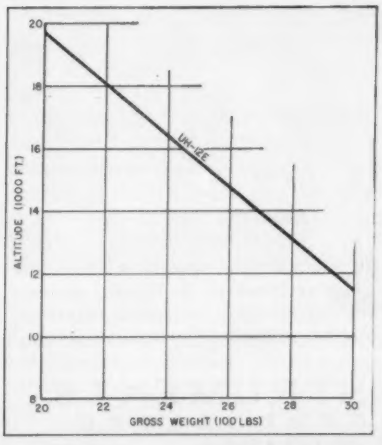
	Flight Hours Per Year		
Fixed Costs:	400	600	800
Pilot	$7,200	$7,200	$7,200
Wage taxes and compensation insurance	750	750	750
Insurance (public liability and property damage)	500	500	500
Hangarage	250	250	250
Total	$8,700	$8,700	$8,700
Variable Costs:			
Fuel (18 gph. at 35¢ gal.)	$2,520	$3,780	$5,040
Oil (.25 gph. at $1 gal.)	100	150	200
Maintenance-labor at $5 hr.	2,800	4,200	5,600
Engine major overhaul—labor	600	900	1,200
Engine parts (at $1.75 hr.)	700	1,050	1,400
Helicopter parts (at $8.06 hr.)	3,224	4,836	6,448
Supplies	200	300	400
Total	$10,144	$15,216	$20,288
Helicopter Depreciation:			
$59,950 (over 5 years, 30% residual)	$8,393	$8,393	$8,393
Operating Cost:			
(Total of fixed, variable and depreciation)	$27,237	$32,309	$37,381
Operating Cost Per Hr.	$68.09	$54.62	$46.73

plated. Foot pedals have a 2-in. adjustment.

The VO-540-A1A engine had a float type carburetor installed which uses an extra 5-plus hp. While not as efficient as the pressure-type carburetor, the float-type is less complicated in maintenance. The engine itself now runs 600 hr. between overhauls, and is expected to reach the 1,000-hr. level within a year or so.

The engine was quickly cranked up and we were ready for takeoff, grossing about 2,300 lb. Field elevation at the airport was 180 ft. Sea level pressure was 29.90 in. Outside air temperature was 23C and a light wind of 2 kt. was blowing from the northwest.

The twist-grip engine throttle is located on the collective pitch lever. At full power–28.5 in. manifold pressure and 3,200 rpm.–the light helicopter was pulled straight up, circling tight, to 1,000 ft. With power reduced to 20 in. and 3,100 rpm., the 12E shot forward at an indicated speed of 95 mph. It was flown about eight miles out of the control area for this check-out.



SERVICE ceiling vs. gross weight chart.

Highly Maneuverable

The 12E is highly maneuverable, and we practically split-S'd down from altitude. Tight turns were introduced, both left and right. The rotorcraft evidenced good stability for a helicopter, though fairly sensitive to this pilot.

At one point, coming down–holding 2,300 rpm. and about 23 in. manifold pressure, without dropping collective–thrust was rolled in and altitude and rpm. recovered at 300 ft. without any forward speed. The 12E was then pulled up vertically to 700 ft. at about 700 fpm.

There was no rate of climb indicator in the demonstrator, and ascents were estimated by taking a time clock. Vertical climb to 1,000 ft.–pulling 28.5 in. and 3,200 rpm.–was made in 35 sec. This checked out to be about 1,720 fpm. Optimum climb to 1,000 ft., following takeoff speed of 45 mph., was made in 30 sec.–at an estimated rate of 2,000 fpm. Best climb speed is 54 mph.

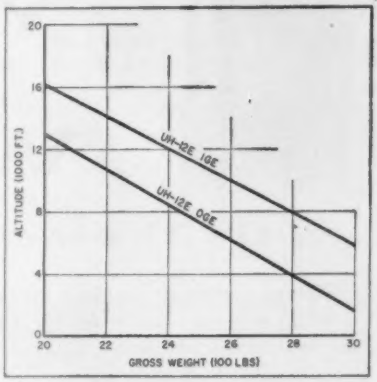
Hovering at 700 ft., with power to 20.5 in. and 3,100 rpm., posed no power or stability problems, rotorcraft being rotated left and right. At about 5 ft. altitude the 12E was hovered at 19 in. and 3,200 rpm. Electric stick trim quickly relieved stick forces (there are no servos). Backward flight was made at 50 mph., with power to 18 in. and 3,200 rpm., full 360 deg. turn to left being made at 40 kt.

A low-altitude, high-speed run was made with power to 24 in. and 3,200 rpm. At this setting the 12E quickly moved up to 105 mph. indicated airspeed, at which point the stick began to shake with the speed, a characteristic of the rigid rotor system. Sea-level never exceed speed (V_{ne}) of the 12E is 96 mph. indicated, which is to be decreased 2.5 mph. per each 1,000 ft. of altitude above 5,000 ft.

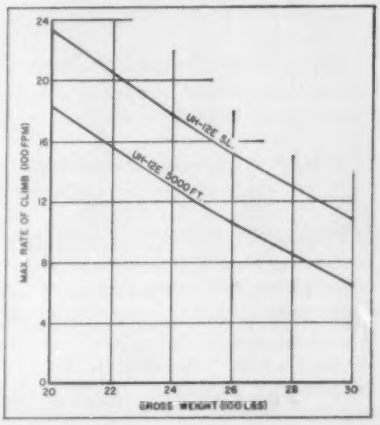
Rotor Limit Speed

Maximum rotor limit speed is 395 rpm.; minimum speed is 314 rpm. Suggested speed during autorotation is 50 mph. Autorotation was made from 500 ft., at this approach speed, with split needles showing rotor rpm. to be 370, then dropping to 350. The helicopter, momentarily cushioned via collective, was skidded onto the grass, touching down at about 12 mph.

Off the ground again, the 12E flew hands-off for but a few seconds in hover (at 20 in. and 3,100 rpm), but couldn't quite make it by itself. Maximum recommended ground contact speed for a running landing is 40 to 50 mph. Hovering and landing control of the 12E have been demonstrated to



HOVER ceiling vs. gross weight, 12E.



MAXIMUM rate of climb vs. gross weight.

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***Target acquisition and recognition:* You can search a huge area in minute detail for widely separated, lethal forces and installations — many of which are highly mobile.

***Target location:* through navigational aids so accurate that conventional warheads may be used on concentrated targets with a high probability of success.

***Data Handling:* to interpret and relay the target data from TI-equipped drones and snooper aircraft to the field commander in useable form.

***Weapon damage assessment:* verifies weapon accuracy and evaluates the remaining threat.

Plus: training aids and maintenance services to assure that both men and equipment are at top efficiency.

This capability now exists at TI, with the latest and most sophisticated airborne reconnaissance systems being flown daily at TI's Avionics Test Center.

For detailed discussion of TI Surveillance hardware, currently in production for the USAF and US Army Signal Corps — cleared personnel "with need to know" are urged to call or write: SERVICE ENGINEERING DEPT.

RESEARCH/DESIGN/DEVELOPMENT/MANUFACTURING of systems for: *Air traffic control • Airborne early warning • Antimissile • Antisubmarine warfare • Attack control • Countermeasures • Missile systems Navigation • Reconnaissance • Space electronics; and on detector cells, engine instruments, infrared, intercom, microwave, optics, sonar, radar, telemetry, time standards, timers, transformers and other precision devices.*

APPARATUS DIVISION

TEXAS INSTRUMENTS
INCORPORATED
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12E Specifications

Fuselage length (maximum)	27.8 ft.
Fuselage width (maximum)	5.0 ft.
Height to top of cabin	6.1 ft.
Height to top of rotor	9.8 ft.
Cabin dimensions:	
Width (maximum interior)	4.9 ft.
Width (at seat)	4.7 ft.
Length (seat to nose)	4.7 ft.
Height (floor to roof)	4.4 ft.
Main rotor diameter (two blades)	35.4 ft.
Tail rotor diameter (two blades)	5.5 ft.
Empty weight	1,700 lb.
Useful load	1,000 lb.
Gross weight	2,700 lb.

Engine: Lycoming VO-540-BIA six-cylinder opposed aircooled engine rated at 310 hp. at 3,300 rpm. at. sea level

be adequate in winds up to 18 kt.

Visibility during all phases of the flight was good, and the noise level was moderate for this type of aircraft. There is no question as to the power capabilities of the 12E, which will transport 65% more payload 50 mi. further, and hover in ground effect four times higher than its commercial predecessor, the 12C.

A single system provides lubricating oil to the engine, main transmission and fan gear box. An external oil tank is required since the engine is the dry sump type. An oil screen is furnished as an integral part of the engine. Both the engine and main transmission are pressure fed by the engine oil pressure pump.

A drain return from the transmission lubricates the fan gear box.

The engine is cooled by a pressure type axial flow fan mounted integrally with the engine. The fan also provides cooling air for the generator and oil cooler. Separate exhaust mufflers are provided for each bank of cylinders. Muffs are available for carburetor air heat and cabin heat.

Available as optional equipment are both the Narco VC-27B Simplexer (one watt, 27 crystal-controlled channels) and the new Narco Mark V (five watts, 90 crystal-controlled transmitter channels, 190 crystal-controlled receiver channels), which costs $1,716 installed. Both radios are equipped with low-frequency receivers. Two combination headset microphones are furnished with each installation.

Additional optional equipment (with installed-in-production price) includes: a hydraulically operated rescue hoist with 100 ft. of steel cable and a load capacity of 250 lb. ($7,946); a quick-attach cargo hitch, secured to the helicopter's keel, incorporating a solenoid release actuated by a button on the cyclic stick and with emergency foot-operated mechanical release ($796); twin litters for air-ambulance utilization (loose kit is $3,736); cargo racks which mount on the skid gear cross tubes on each side of the fuselage ($688).

Rubberized-canvas floats, which cost $2,680, equip the rotorcraft for amphibious operation. Installation of dual 40-gal. auxiliary fuel tanks, which cost $2,145 installed, will almost double the 12E's range. De luxe cabin interior runs to $540.

The 12E and the military H-23D are being produced at the combined rate of about 18 per month, with rate continually rising, AVIATION WEEK was told. Delivery of the 12E is occasionally immediate, but usually runs from 60 to 90 days following an order. Demonstrator is the only 12E sold in Europe, as company is concentrating on the domestic market.

12E Performance

Maximum gross weight	2,172 lb.	2,700 lb.
Useful load	472 lb.	1,000 lb.
Empty weight	1,700 lb.	1,700 lb.
Maximum speed (Vne)	96 mph. IAS	96 mph. IAS
Cruise speed (maximum range)	84 mph. IAS	84 mph. IAS
Cruise speed (maximum endurance)	52 mph. IAS	54 mph. IAS
Cruise speed (75% power)	95 mph. IAS	95 mph. IAS
Range (at best cruise)*	230 st. mi.	215 st. mi.
Endurance:*		
At maximum range speed	2.7 hr.	2.5 hr.
At maximum endurance speed	3.4 hr.	3.2 hr.
Maximum rate of climb	2,070 fpm.	1,400 fpm.
Maximum ceiling	19,200 ft.	15,000 ft.
Service ceiling(100 fpm. maximum rate of climb)	18,000 ft.	14,000 ft.
Hovering ceiling (IGE)	14,400 ft.	8,950 ft.
Hovering ceiling (OGE)	11,000 ft.	5,050 ft.

*(Five-minute warm-up and hover allowance included).

New Tri-Pacer Cruises at 138 mph.

Streamlined wheel fairings are featured on both the 1960 Tri-Pacer and low-cost Caribbean version, increasing cruise speeds to 138 mph. and 136 mph., respectively. Speed fairings are major external change on new versions of four-place business plane, interior and exterior restyling are also incorporated. AutoFlite version of the 1960 Tri-Pacer, incorporating a transistorized gyro-stabilized unit for hands-off flight, will list at $11,970; the standard model will sell for $9,340. Piper general sales manager J. W. Miller predicts that 90% of Piper's 1960 Tri-Pacers will be with the AutoFlite system installed. Caribbean—formerly the 150-hp. Tri-Pacer—can also be purchased with speed fairings. De luxe Caribbean will sell for $9,750. Deliveries of the Tri-Pacer started to Piper dealers last month.

Mobil — FLY WEATHER-WISE

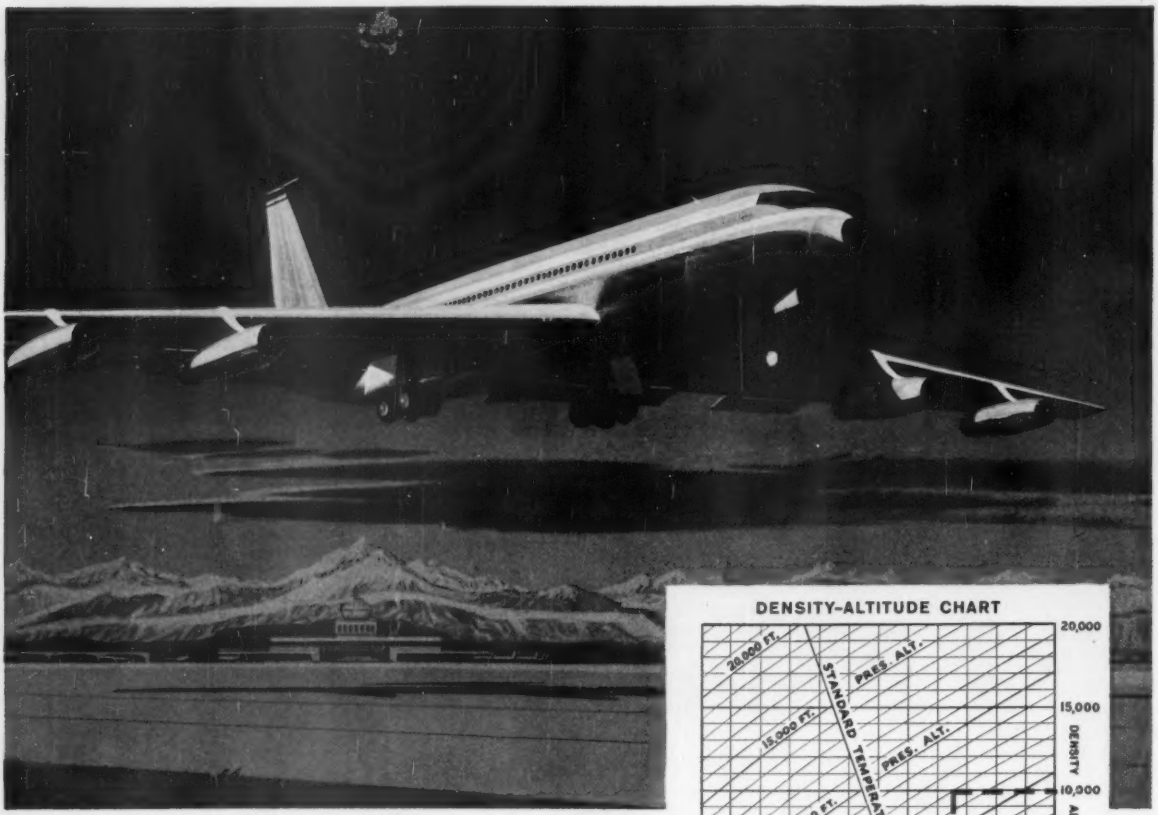
AIR DENSITY

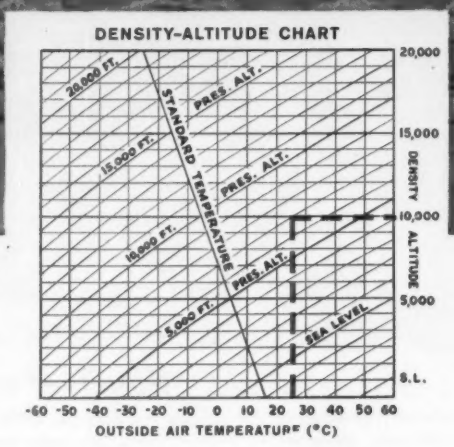
EFFECT ON FLIGHT

These weather items prepared in consultation with the United States Weather Bureau

Air density plays an important part in the take-off and flight performance of today's gas-turbine aircraft. Low densities reduce engine thrust and aerodynamic lift. Since density decreases with altitude, the higher the altitude the longer the take-off run. Therefore the density at airport altitude (Density-Altitude) is an important factor in calculating maximum fuel load and pay load. Barometric pressure and ground air temperature affect density. As both are continually changing, the Density-Altitude of the airport continually changes—may vary as much as several thousand feet a day.

Density-Altitude can be determined by knowing barometric pressure (at airport, not sea level) and temperature. Charts similar to the one below can be used.





Charts like this are useful in determining Density-Altitude. The Pressure-Altitude (reading when altimeter is set at 29.92) and the Temperature at the airport a entered to find Density-Altitude.

Today, more than ever, it is important to select a jet fuel with the right performance over the full range of varying atmospheric conditions. Mobil has developed a complete line of such quality jet fuels—Mobiljet 140, Mobiljet 158 and Mobiljet 476. Fly weather-wise . . . fly Mobil.

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Airport Built to Serve Resort Area

By William S. Reed

Lake Tahoe, Calif.—Opening of the winter Olympic games soon is expected to be a strong stimulant to traffic for El Dorado County's new airport 40 mi. distance from the Squaw Valley competition site.

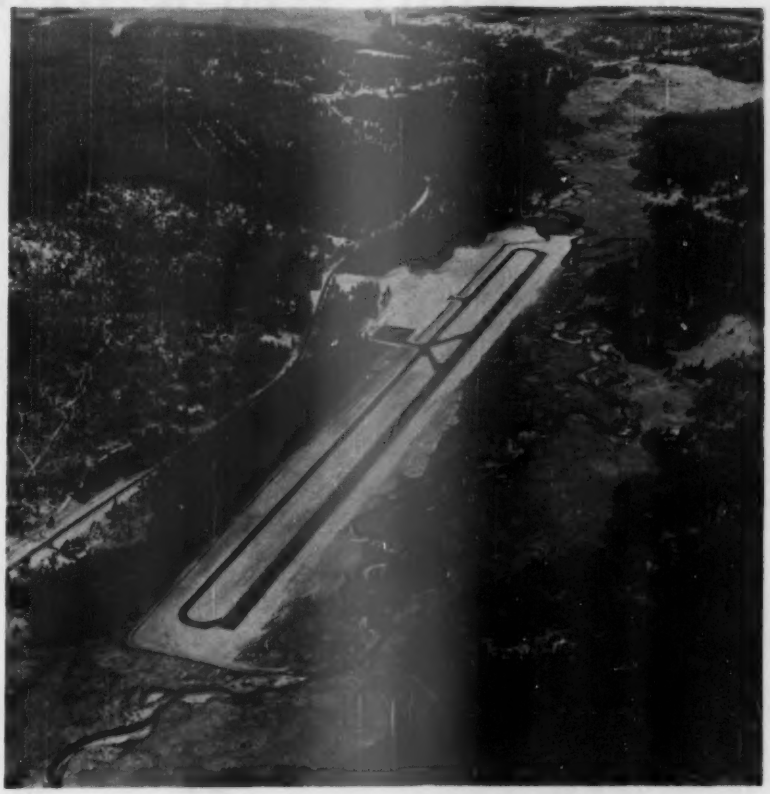
Airport building is running counter to the trend in California these days where commercial and real estate interests are whittling away at available sites.

But El Dorado County business interests see the field playing a prominent role in future growth of an already booming tourist trade.

Located about three miles from the south shore of Lake Tahoe, the airport has a 5,900 x 100 ft. asphalt strip running north and south. Tie-down provisions are available for 300 aircraft with provisions for additional aircraft to be added soon. Communications facilities presently consist of Unicom on 122.8 mc. Elevation of the field is 6,263 ft. and, for a mountain airport, the approaches are good.

Airport Manager M. T. Wordell said that requests have been filed with the Federal Aviation Agency for additional facilities including an omnirange transmitter, control tower, and weather facility. Installation of these items is, of course, up to FAA, but Wordell is optimistic. Raising funds for the airport has been a joint federal-El Dorado County venture.

Weather advisory and flight plan filing must be done via telephone to Reno, Nev., but if traffic continues at its present pace, a direct line will be warranted. On Aug. 30, only four weeks after the formal opening, better than 150 aircraft moved in and out of the airport.



LAKE TAHOE AIRPORT in California, bordering Nevada, is 6,263 ft. above sea level. Airstrip is 5,900 ft. long x 100 ft. wide. South shore of lake is in upper center.

Resort Attractions

El Dorado County Planning Commissioner Ray Chism pointed out these features of the Lake Tahoe area as reasons for justifying the airport for business and private pilots:

- **Lake Tahoe itself,** clear and fed by mountain snow water, offers fishing, boating, swimming and water skiing. The surrounding mountainous area also offers hiking, camping and many other summer sport activities.
- **Winter sports,** primarily skiing, are offered in abundance. Heavenly Valley, six miles by road from the airport, features a recently completed chair lift for skiers in winter or for sightseeing the year round.
- **Accommodations are plentiful** in the numerous motels located in the several small communities in the South Lake Tahoe area.
- **Entertainment features** big name entertainers at such places as Harrah's Club and Harvey's just across the state line in Nevada. From the airport, it is six miles by free bus transportation to the stateline where a smaller but no less active extension of Reno and Las Vegas begins.

Although the airport is in California, Chism said a good part of the traffic will undoubtedly be due to the Nevada night clubs but the airport and surrounding communities will share in the resulting prosperity. A Harrah's Club spokesman said it is presently the country's third largest user of commercial bus transportation and it is planning aircraft charter flights now that the airport is completed. Pacific Airlines has applied for a franchise to serve the airport on a scheduled basis. Although considerable snow falls in the area, county officials expect no trouble keeping the airport open, pointing out that highways are kept passable in winter except during and immediately after heavy snowstorms.

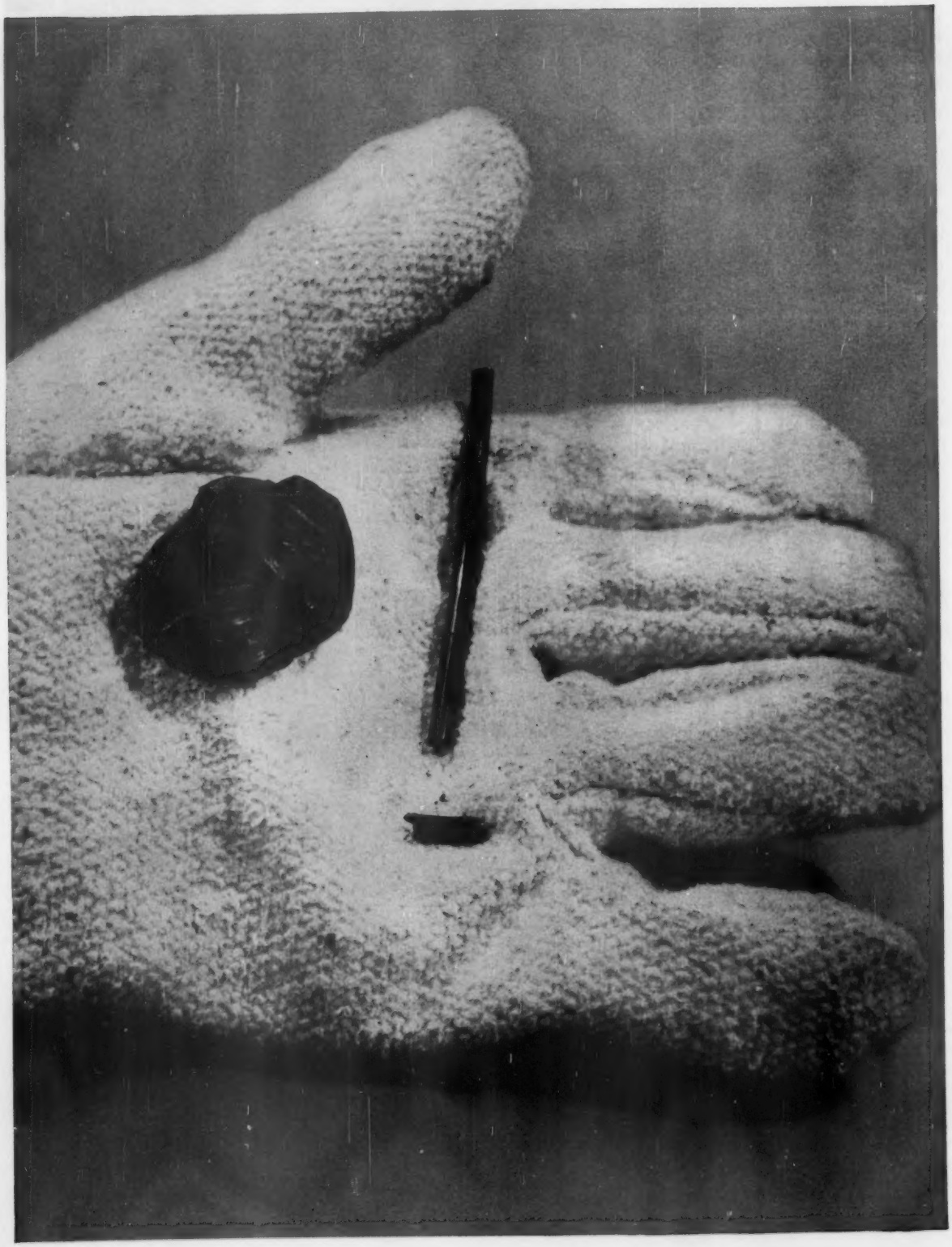
Although Lake Tahoe airport is 6,263 ft. above sea level, it is considerably safer than many mountain airports. It doesn't have, as many of them do, a no-go-around approach. Landings and takeoffs can safely be accomplished to both the north and the south. Terrain to the north is better, however, since a flat meadow extends to the lake. Wordell admits that some pilots have had difficulty taking off because of a lack of respect for the inherent limitations of their aircraft when operating at high altitudes. He points out that the airport's 5,900 ft. length is equivalent to a 3,500 ft. strip at sea level.

Judgment Required

It is also advisable, he said, to exercise the usual precaution and judgment necessary in operating in turbulent mountain air. Wordell and any of the other local pilots experienced in the area are always willing to point out the safest routes and procedures they have worked out from experience. Although some smaller, less powerful aircraft may have difficulty on hot summer days if proper techniques are not used, the Cessna 310B in which this AVIATION WEEK pilot flew into Lake Tahoe had no difficulty with full fuel and five passengers.

Year-round charter service, rental and flying instruction is available from Bridgeford Flying Service which has

Solid Fuels are simple—



but!

Whether the rocket power be for the Army's Sergeant, the Air Force's Minuteman or tomorrow's 50,000,000 lb. thrust motor it begins with globs and strands of fuel held in the asbestos-gloved hands of the research chemists.

For more than ten years the research scientists in THIOKOL's Rocket and Chemical Divisions have been continuously engaged in rapidly expanding programs of propellant development.

In these endeavors one fact is common: new propellants are cast into rocket motors only after many thousands of hours have gone into research and testing. For every successful propellant formula there are many, many frustrating failures. This is the way of research. Success, even though it comes slowly, is the reward.

Fortunately, success has come to THIOKOL research scientists in abundance and with regularity.

The variety of career opportunities at THIOKOL is large and expanding, including:

Propellant analysis and formulation • Polymer research • Fluorine and metal hydrides synthesis • Shock wave phenomena • Combustion processes • High vacuum techniques • Fast reaction kinetics • Servo system and electro mechanical design • Instrumentation • Ion and plasma propulsion • Magnetohydrodynamics • Thermodynamics • Solid state physics.

There may be a place for you on the team, working on THIOKOL — developed-and-built rocket powerplants used in the Falcon, Sergeant, Matador, Nike Hercules, Lacrosse, X-17, Minuteman, Pershing, Nike Zeus, Sparrow III, X-15, Bomarc, Little Joe, and Bullpup.

For further information contact Personnel Director of any of these plants: Huntsville, Ala.; Elkton, Md.; Moss Point, Miss.; Brigham City, Utah; Trenton, N. J.; Bristol, Pa.; Denville, N. J.; Marshall, Texas.

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exclusive rights to operate at the airport.

Dick Bridgeford, operating a fleet of 34 aircraft in charter and flying services at three locations in northern California, said he will have personnel, aircraft and equipment permanently based here as soon as hangar facilities are completed. Also, night operations will commence when night lighting installation is completed. Equipment is now on site and awaiting installation.

U.S. Company Making Mid-East Air Survey

Beirut—Indications are that the Russians, who practically have a monopoly in aerial survey services in the United Arab Republic, are facing competition from a U. S. firm in this Middle East area.

Two UAR government agencies—the General Petroleum Authority and the Desert Reclamation Authority—are negotiating a survey contract with the Aero Service Corp., Philadelphia, Pa., according to industry observers here.

For the past two years the Russians have been using two Il-14s on a complete geological map of the Syrian region—charging less than 50% of the fees bid by Western firms and offering easy credit terms as part of the economic and technical aid agreement between the USSR and the Syrian and Egyptian regions of the UAR.

Aero Service, and its affiliate, Canadian Aero Service, Ottawa, have started an airborne magnetic survey of portions of Turkey considered areas for potential mining and petroleum resources. The project, covering one third of the country, is expected to take two years and includes compilation, interpretation and correlation of magnetic data by the company's geophysics department with field checks to be done on the scene and recommendations made on possible exploitation.

Aero Service is using a Douglas DC-3 and twin-engine Beech, utilizing Radan doppler navigation. The Turkish project is Aero Service's first major project in the Middle East since it opened a permanent office to cover the area in Beirut last April.

There is increasing interest in the Middle East by underdeveloped countries to develop their natural resources. Previously interest was in aerial survey primarily by private oil companies. Stressed are not only surveys for oil but also mapping, photography and other surveys for industrial and agricultural development.

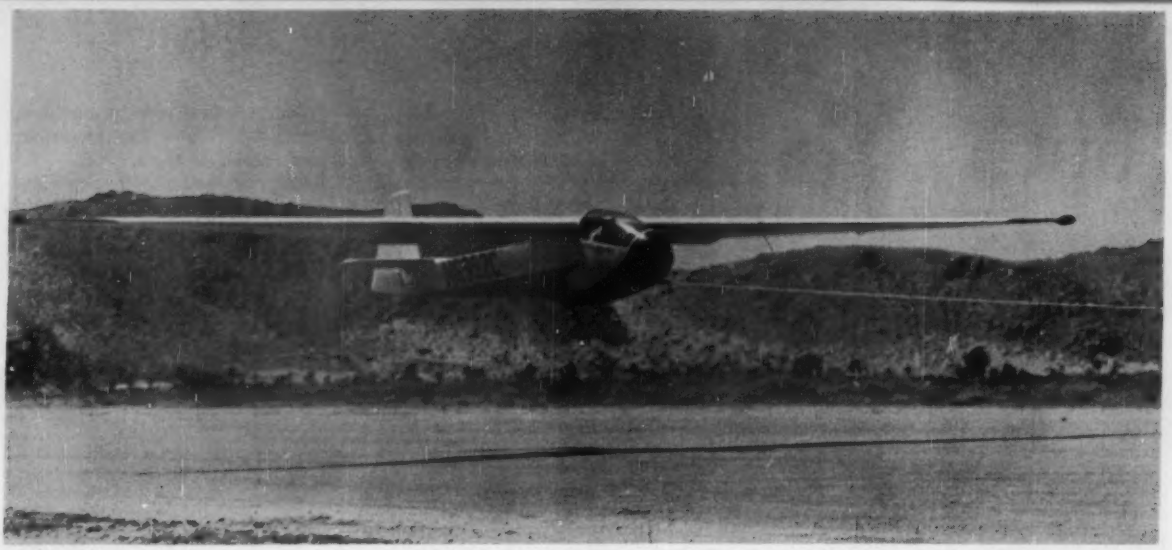
Aero Service now has 16 pilots, electronics engineers and geophysicists working in the Middle East.

U. S. Business & Utility Aircraft Shipments

AUGUST, 1959

Manufacturer and Model	No. of Units	Net Billings
Aero Design 500	8	
560E	4	
680E	1	$974,000
720	1	
Beech 185	9	
Bonanza	41	
Mentor	44	4,113,000
Twin Bonanza	8	
95 Travel Air	10	
Call Air Model A5	2	13,000
Model A6	—	
Cessna L-19	—	
150	63	
172	41	
175	43	3,113,000
180	22	
182	52	
310B, C	19	
Champion Model 7EC	—	
Model 7FC	12	
Model 7GC	2	134,000
Model 7HC	9	
Colonial Skimmer IV	—	—
Hello H-391B and H-395	7	379,000
Mooney Mark 20	18	195,000
Piper Super Cub	40	
Tri Pacer	42	
Apache	26	2,469,000
Comanche	75	
Pawnee	—	
Totals	608	$11,380,000

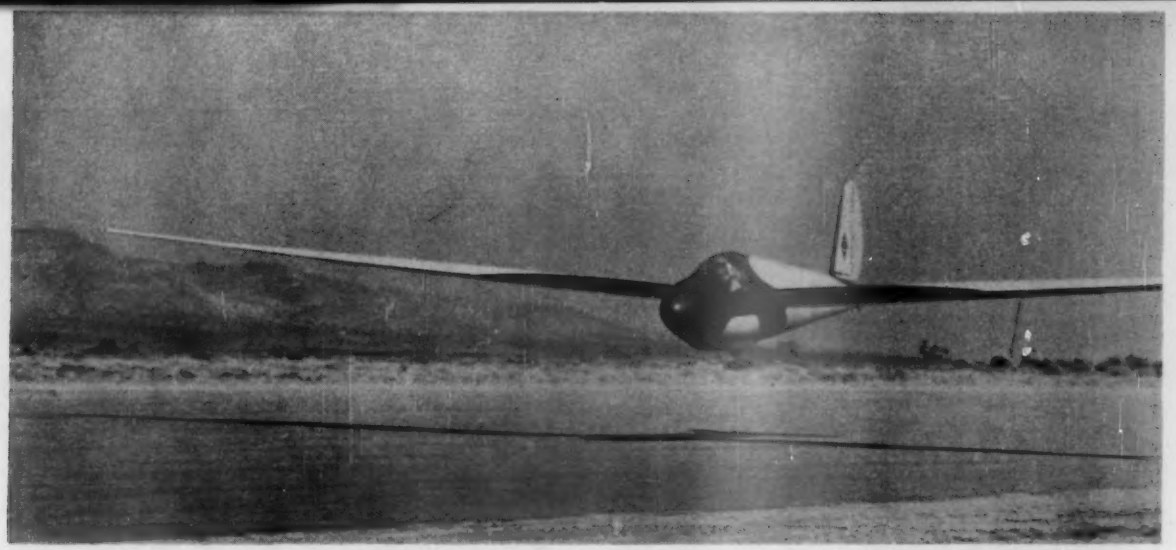
U. S. business and utility aircraft shipments, January-August, 1959, total more than 5,240 units with a manufacturers net billing total value exceeding $90 million. This compares with approximately 4,350 units valued at more than $69.7 million shipped in the same period in 1958, reflecting the continued increase in number of units and dollar value occurring in every month this year compared with similar months last year. With four months yet to go, indications are that the business aircraft industry will go well over its 1958 record, when it delivered 6,416 units with a total billing value of approximately $103 million.



Briegleb BG-12A begins tow to 2,000-ft. release altitude. Sailplane uses flaps instead of spoilers (shown in takeoff position above).

NASA Official Takes First Place in

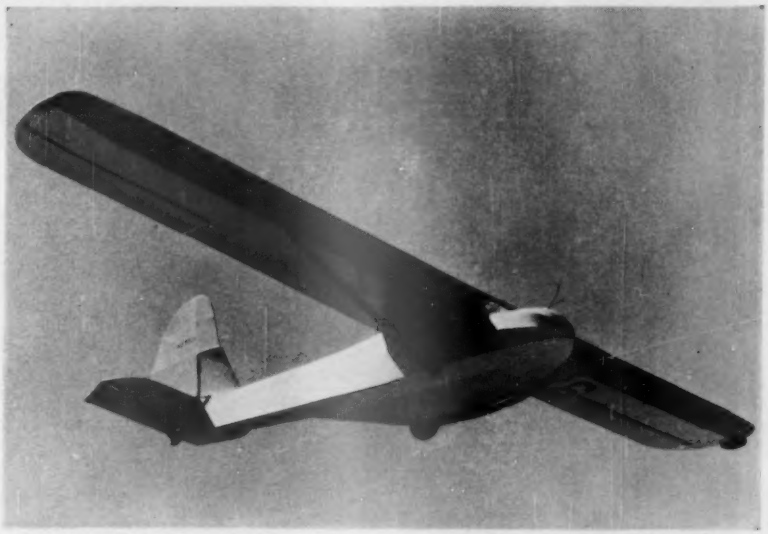
Prue 2 (both photos above) took second place. It is intended for soaring in weak thermals and has lower aspect ratio and wing loading than true racing sailplanes. Glide ratio is 35.8 at 69 mph. and design top speed is 150 mph. Empty weight is 916 lb.



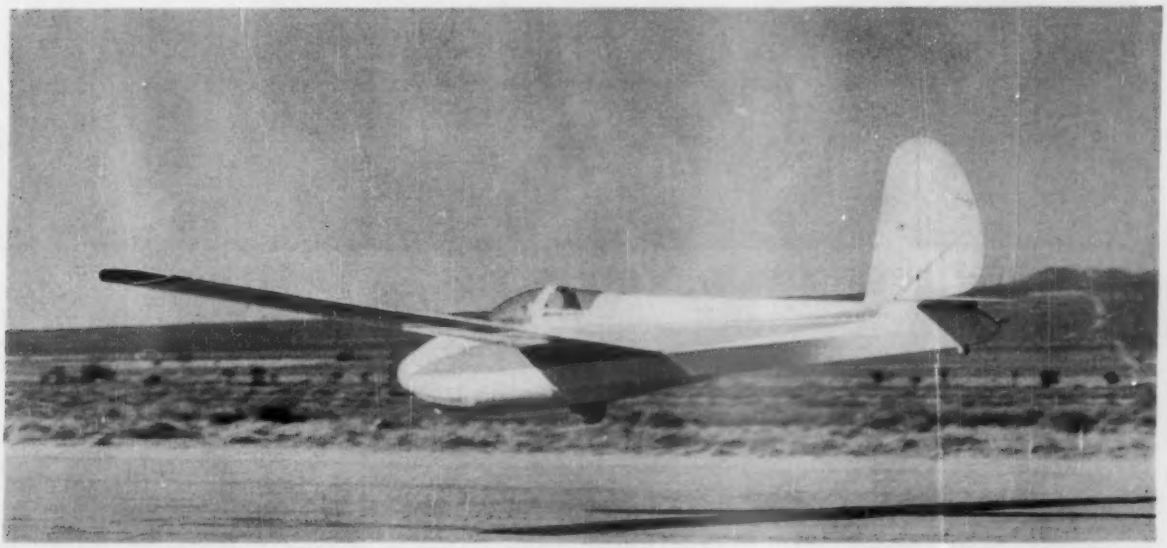
Winner Paul Bikle lands his Schweizer 1-23E after completing 98 mi. cross country race from El Mirage to Daggett and return.

Glider Meet

El Mirage, Calif.—Flying his Schweizer 1-23E high-performance sailplane, Paul Bikle, chief of National Aeronautics and Space Administration's High Speed Test Station, Edwards AFB, took top honors in the three-day, 1959 West Coast Soaring Competition here. Meet, sponsored by Antelope Valley Soaring Club, attracted some of the most interesting sailplanes now flying on the West Coast, including Briegleb BG-12A, Prue 2 and the older Prue 160. Two-seat Prue 2, flown by Lyle Maxey, placed second. Third place was taken by John W. Williams in a modified Schweizer 1-23. A desert site was picked since it is the only place suited to year-round soaring in the area. Contest consisted of daily cross-country round-robins over distances up to 99 mi. Bikle was only pilot, of 18 competing, to finish on all three days of the meet.



Open cockpit 1938 Schweizer 1-7, believed to be the last one still flying, takes off in tow.



Host club's new Schweizer 1-26 (AW Sept. 7, p. 117) touches down on the desert runway. Airplane did not compete in meet. It has a gold plated stick to commemorate the fact that it was the 100th of its type delivered by Schweizer Aircraft Corp.

give my regards to Venus. Messages like that may become matter-of-fact sooner than we think. The field of space communications is one in which we at Bendix Radio are making exciting progress. Our engineers are developing systems to provide communication links with the first manned space vehicles, and we are already playing a major part in communications and tracking in connection with the earth satellite program. **Also under study** at Bendix Radio are improved systems for more conventional applications—such as speech security and forward scatter. *Your* problems in communications could well find their answer with us.

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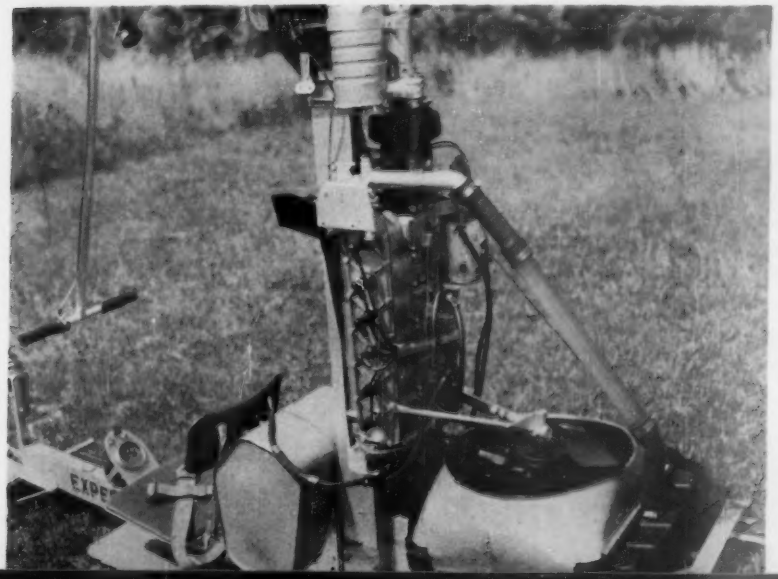
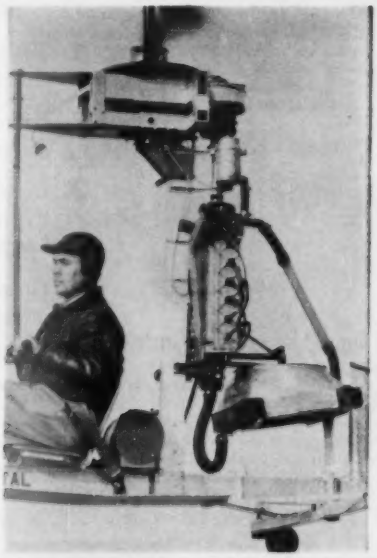
Bensen B-9 "Little Zipster" helicopter's gross weight is 700 lb., useful load 250 lb. and cruising speed 60 mph. Hovering ceiling in ground effect is 6,000 ft.; absolute ceiling is 12,500 ft. Endurance is 2 hr. and range is 100 mi. Rotor diameter is 22 ft.

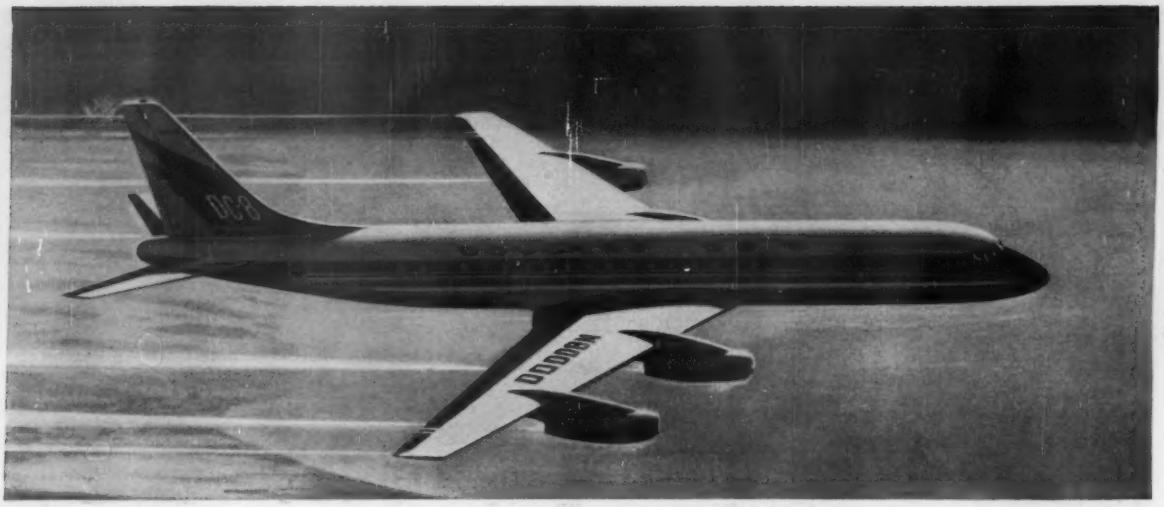
Bensen Unveils Coaxial Helicopter

First photos show coaxial, counter-rotating helicopter built by Bensen Aircraft Corp., Raleigh, N. C. Model B-9 uses a chain and sprocket drive in last stage of transmission; rotor blades are interchangeable with predecessor B-7 and B-8 gyrocopters. The B-9 has not yet been type certificated by Federal Aviation Agency and therefore is not generally available in the U. S. Fully assembled export model costs $6,995. Low disk loading of rotors is designed to improve maneuverability. Disk loading is 1.84 psf.



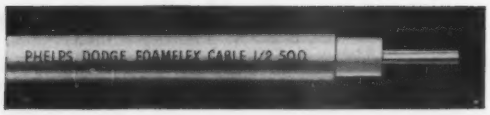


Mercury Mk. 75 modified outboard engine delivers 60 hp. Radiator and fan were added for water cooling. Standard equipment includes 12-v. battery, electric starter, airspeed indicator, engine tachometer, safety belt, manual choke, wheel-type landing gear and coolant thermometer.



REQUIRED: A lightweight, low-loss, radiation-free cable with electrical uniformity for interconnecting the navigation and communication antenna circuits of the Douglas Aircraft Co.'s new DC-8 jet airliner.

SPECIFIED: *Foamflex® Coaxial Cable*



A semi-flexible cable with tubular copper inner conductor, foamed polyethylene dielectric and commercially pure aluminum outer conductor.

With outstanding advantages for use in aircraft navigation, communication and warning circuits that include:

1. Twice the efficiency of solid dielectric (RG-8A/U) type of cable now in general use.
2. Extended life characteristics that permit permanent installation and assure electrical stability during the life of the plane.
3. Good frequency response over wide temperature variations; capable of withstanding highest summer ground temperatures, as well as extremely low temperatures found at high altitudes.
4. Greater efficiency and improved system performance without the use of additional electronic components.
5. Ability to operate in both pressurized and non-pressurized parts of a plane without the use of cable dehydrators or pressurizing systems.
6. Lighter and smaller than many cables now installed in aircraft.

Foamflex coaxial cable is supplied in long lengths on lightweight, disposable reels. For further information or inquiries, write Dept. FC.

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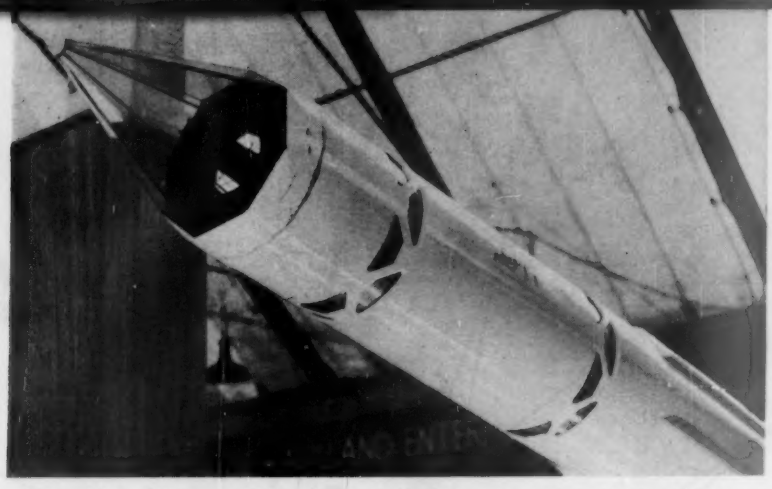
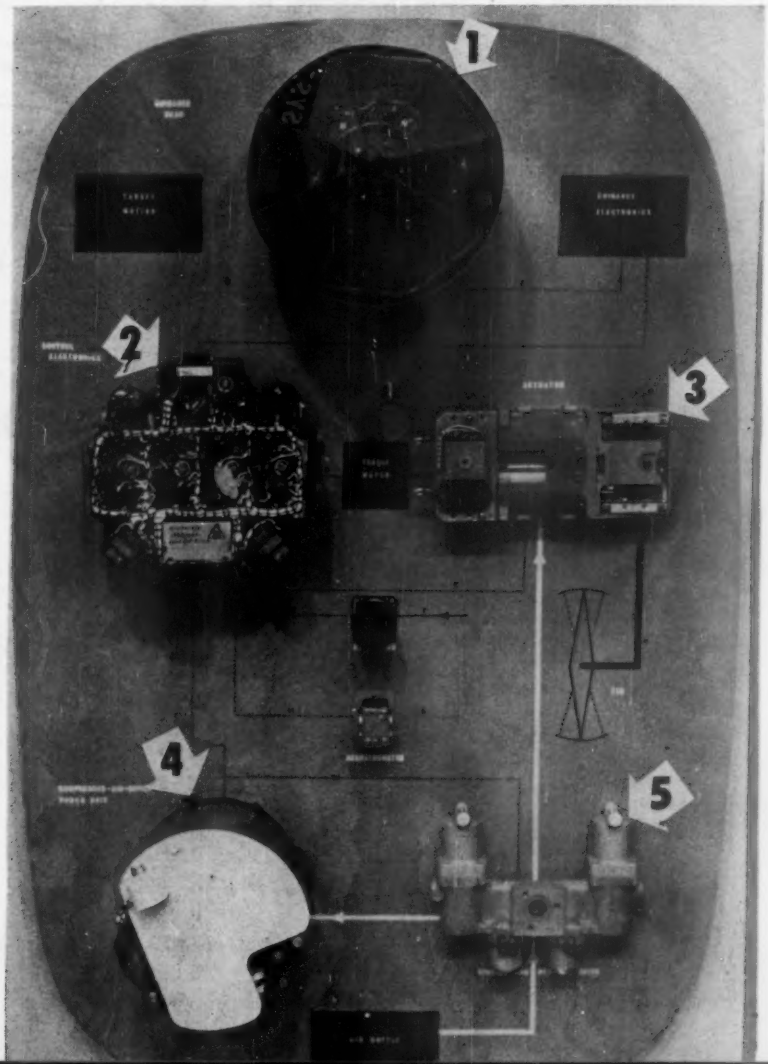


De Havilland Displays Firestreak Homing Unit

Octagonal conical head of de Havilland Firestreak missile (above) houses infrared detector which supplies input data to active homing system. Two rings of trapezoidal openings around Firestreak body are infrared proximity fuze system, working by triangulation on heat source in target. Openings are painted inside to conceal components of fuze. Components of infrared homing system (below) were displayed by de Havilland Propellers, Ltd., at 20th Society of British Aircraft Constructors display at Farnborough, England. Motion of tracking infrared head in glass nose (1) feeds signals to avionic control unit (2) which programs torque motor which drives control surface actuators (3). Missile acceleration produced is compared with demand in avionic control unit. Power for system comes from power unit (4) which is driven by air bottle; compressed air from bottle also supplies actuators through valve system (5).



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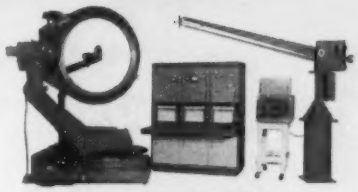
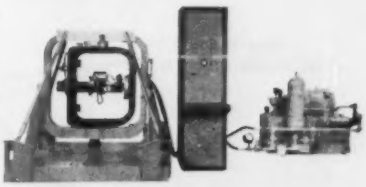


Radome Boresight Error

The CTI Radome Boresight-Error Measuring System satisfies MIL-R-7705A(ASG), including type II radomes. Boresight error is automatically recorded directly in milliradians with an accuracy of ±0.1 milliradian. Percent transmission and antenna patterns with or without the radome are also plotted. Available from S through K_a bands and infrared. Model 150C for monopulse and conical scan, Model 1508 for bombing-type and other shaped-beam radars.



Flight and Altitude Simulation

Three-Axis Flight Simulator reproduces roll, pitch, and yaw positions, velocities, and accelerations for accurate analysis of flight control systems and inertial guidance platforms in the laboratory. Dynamic Altitude Simulator (not shown) produces 0-to-10-cps altitude fluctuations through range of ±700 feet at levels up to 80,000 feet.

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Only automatic testing can assure the reliability of electronic equipment where time, manpower, or accuracy is critical. Used for pre-flight, maintenance, and production tests, CTI devices locate faults and incipient failures in seconds. Model 180 Tape-Programmed Supertester for circuits and systems; Model 165 Cable Tester for wiring harnesses; custom equipment to your requirements.

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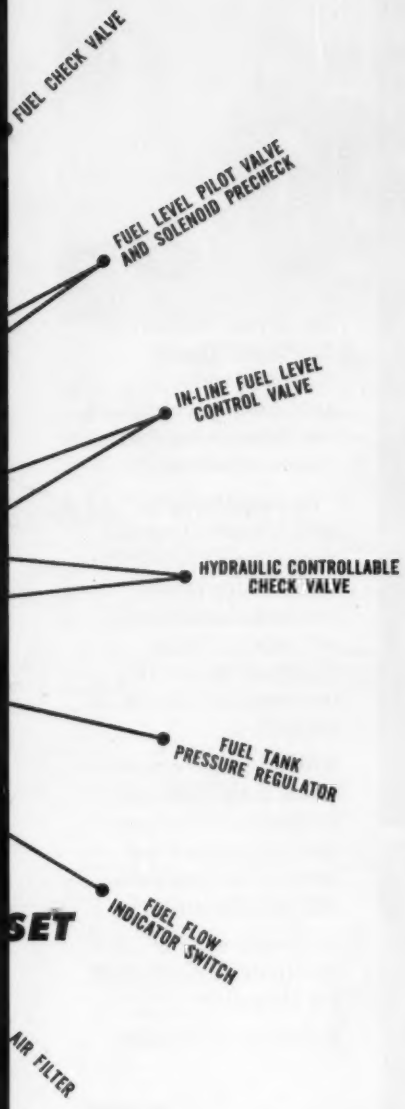

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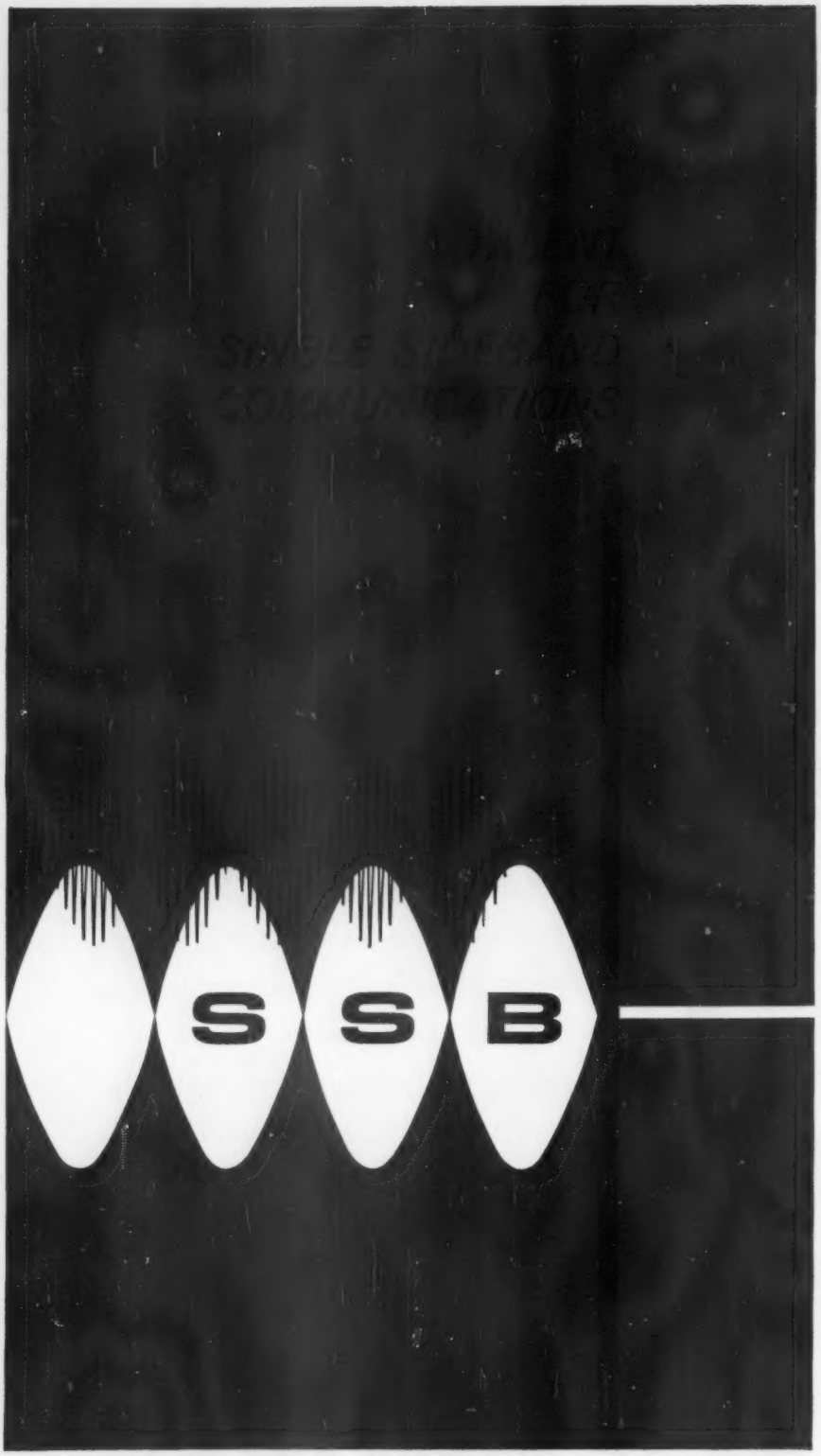

Stromberg-Carlson is now developing for the Armed Forces... Advanced Single Sideband radio applicable to shipboard, vehicular and airborne communications.

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Quail Is Positioned for Loading on B-52

McDonnell YGAM-72 Quail decoy missile is about to be attached to the belly of a Boeing B-52 at Air Proving Ground Center, Eglin AFB, Fla. Missile's fins are folded until after release from the bomber (AW Dec. 8, cover). Quail is powered by a General Electric J85 (2,500 lb. thrust).

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command.

Sundstrand Aviation Division, Sundstrand Corp., Rockford, Ill., 18 ea., transmission assemblies, Sundstrand P/N M627219; 7 ea., frequency and load controllers, P/N 669970, spare parts and maintenance tools and test equipment for SM-62A missile, (PRs EA-9-031-4621 and amendment no. 1; EA-9-03C-4620), $148,770.

Hamilton Standard Division, United Aircraft Corp., Broad Brook, Conn., 16 ea., inverters, static, 100 kva., three-phase (service test), (aircraft not available), RFP 33-600-59-5064 (PR EA-9-03C-4734), $52,384.

Aeronautical Division, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., 300 ea., accelerometers, P/N GG 22-C1; component of type AN/AJB low altitude bombing systems for use in the F-100 aircraft, (PR WR-9-1280-851), $85,290.

Hughes Aircraft Co., Culver City, Calif., various components for the MA-1 aircraft and weapons control systems, engineering service and materials, installations support devices and data for the F-106 aircraft, (PR EG-9-11B-4768), $5,800,000.

Hughes Aircraft Co., Culver City, Calif., services and materials necessary to modify two (2) F-106A/MA-1 systems to accept ARR-61 time division data link and install ARR-61 in modified F-106A/MA-1 systems; services and materials necessary to modify one (1) digital computer subsystem to accept time division data link, (PR EG-9-11B-4994), $480,000.

Bendix Filter Division, Bendix Aviation Corp., Madison Heights, Mich., qualification test report in accordance with specification MIL-T-9107 covering HM-2 modification kit, filter/separator, liquid fuel, type KMK-41 (M32R), (PRs EM-9-4930-6140; EM-0-2330-6143; EM-0-2330-6144), $31,880.

Aircraft Porous Metals, Inc., Glen Cove, N. Y., qualifications test report in accordance with specification MIL-T-9107 covering MH-2 modification kit, filter separator, liquid fuel, type KMK-41(M32R), (PR EM-0-4930-6140), $30,500.

Semi-Conductor Division, Radio Corporation of America, Somerville, N. J., research and development of high frequency silicon transistors, (PR 08832), $42,526.

Lockheed Aircraft Service, Inc., New York, depot level overhaul, drop-in maintenance, overhaul of components, accessories and equipment of C-121A, VC-121E, C-118, C-131D, U-4A, VC-137A, C-123B and H-13G/J aircraft, (PRs MA-0-01A-2, 16 and 84; MA-0-02-D-2-100; SM-60-01-A-6011 and 9604 and amendment no. 1; 0C-0-01F-VC-137-0057 and amendment no. 1), $1,750,000.

Industrial Products Division, International Latex Corp., 9 ea., helmets, high flying altitude, MA-3 (modified); 21 ea., spare replacement helmet liners; 21 ea., space replacement neck seal bladders and data, (PR EM-9-RD-6271), $58,207.

George M. Dorsey, Washington, D. C., 16mm. black and white kinescope negative and 9 ea., 16 mm. black and white prints of 52 ea., 29-min. television program entitled "Chapel of the Air," (PR EM-9-PP-6415), $41,130.

Leland Airborne Products Division, American Machine & Foundry Co., Vandalia, Ohio, 800 ea., rotary inverter, 750, 3/1 phase, 115 v/200 v., 400 cycle output, 26 v.d.c. input, in accordance with specification MIL-I-7023D and amendment no. 2 thereto dated Mar. 14, 1959, and MS drawing 25095-1 (spare parts and data included), for installation and spares for T-33 aircraft, (PR SA-9-03C-9303), $333,340.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., components of the MB-3 and AF/A42G automatic flight control system, for the F-100D/F aircraft and data, (PR MA-9-05F-1066 and amendment no. 1), $1,400,000.

Thomas A. Edison Industries, McGraw-Edison Co., West Orange, N. J., 524 ea., indicator, type MO-2 and data for use on KC-135A, B-58A and HU-1/A aircraft, Aerno 61-2476, (PRs EA-9-05D-4656 and EA-9-05D-4657), $51,906.

General Electric Co., West Lynn, Mass., 511 ea., indicator, rate of flow fuel, type TRU-7/A, Aerno 61-2495 and 410 ea., indicator, rate of flow, fuel, type EFU-3/A, Aerno 61-2492, spare parts and data for use on KC-135A aircraft, (PRs OC-9-05D-10619 and MA-9-05D-768), $357,440.

West Coast Missile and Surface Radar Department, Radio Corporation of America, Los Angeles, Calif., 37 ea., simulator, radar signal, AN/GPS-T2A, spare parts, maintenance and engineering data and installa-

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Box 620-M
Douglas Aircraft Company, Inc.
Santa Monica, Calif.

tion services, (PR PE-9-6910-4290), $596,423.

The Goodyear Tire and Rubber Co., Akron, Ohio, 641 ea., wheel and brake assemblies, installations and spares and data for use on F-105D aircraft, (PRs PE-9-03 B-4282 and EA-9-03B-4453), $228,158.

Lockheed Aircraft Corp., Marietta, Ga., C-130B and SC-130B aircraft and related supplies, (PRs TK-O-1510-5002 and amendment no. 1; TK-O-1510-5009 and amendment no. 1), $3,400,000.

David Clark Co., Inc., Worcester, Mass., 50 ea., high altitude flying coveralls, type GSU-4/P for service test development, (PR EM-9-RD-6371), $28,522.

Aircraft Instruments Co., Radnor, Pa., 1,500 ea., flasher, position light, aircraft SDU-2/A, 28 volt, dc, and data for the RB-66B aircraft, (PR SA-8-03C2-5566), $44,442.

Beech Aircraft Corp., Wichita, Kan., one set five-part technical manual reproducibles in accordance with Army procurement descriptions 55-1 and 55-2 for L-23 aircraft, (MIPR R58-802-TCSMC-A and amendments 19 and 20), $420,000.

Oneida, Ltd., Oneida, N. Y., preparing facilities for shipment, (PR PB-9-F-9043), $83,000.

International Silver Co., Meriden, Conn., preparing facilities for shipment, (PR PB-9-F-9043), $45,000.

Marquardt Aircraft Co., Ogden, Utah, services to provide for testing of RP43 engines used on the IM-99 Bomarc missile, (PR SP-9-2840-4522), $300,000.

Seattle Division, Boeing Airplane Co., Seattle, Wash., metallic rod seals program, (PR 23282), $97,443.

Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J., R-182082WA engines, WF-2, S2F3 aircraft, (MIPR R59-1991-150 NOas), $2,489,899.

Pacific Semiconductors, Inc., Culver City, Calif., 5 watt, 30 mc. silicon NPN transistors and data (aircraft not available), (PR EC-9-16A-4569), $272,380.

Hycon Manufacturing Co., Pasadena, Calif., 65 ea., terrain light detectors, type B-2, Aerno 74-736; 168 ea., computer power supplies, type LA-15, Aerno 74-776; 295 ea., mounting bases, amplifier assembly, type LA-18, Aerno 74-778; components of the universal camera control and camera control systems, for use on RF-101 aircraft, PRs MO-9-6760-2158 and amendment no. 1(C); MO-9-6760-2157 (C); MO-9-6760-2160 (C)), $237,844.

Phaostron Instrument and Electronic Co., Pasadena, Calif., 1,849 ea., indicators, ID 351 B/ARN, Aerno 81-3371 for use in F-86F MDAP, F-100D, et al aircraft, (PRs MD-9-16A-25304 and amendment no. 3; WR-9-MAINT-3922); MD-9-5826-37023; SM-9-16A-1634 (partial)), $569,143.

Lear, Inc., Grand Rapids, Mich., design, develop and fabricate fore and aft acceleration switch and transducer for product improvement, applicable to all aircraft, (PR EA-9-05C-4552), $29,996.

Aerosonic Corp., Clearwater, Fla., 905 ea., indicators, airspeed, pitot static, type MS28045W1, various flow speed aircraft, (PR MA-9-6610-1107 (complete), $43,395.

Harvey Aluminum, Torrance, Calif., replacement billet containers for the government-owned 12,000-ton extrusion press, (PR PB-7-F-6331), $830,000.

Graflex, Inc., Rochester, N. Y., 194 ea., camera sets, 6720-543-2413-J360 for: ground support equipment, (MIPR R59-677-383-NSF), $73,041.

U. S. Gauge Division, American Machine and Metals, Inc., Sellersville, Pa., automatic parachute ripcord releases for test, (PR 56538), $37,564.

Sperry Phoenix Co. Division, Sperry-Rand Corp., Phoenix, Ariz., various components for the E-4, MA-2 and DSCE-80 AFC systems for use in the C-130, B-52 and QF-80 aircraft, (PRs EG-9-05F-4473 and 4571; OC-9-05F-10665), $722,310.

AiResearch Manufacturing Co. of Arizona, Division, the Garrett Corp., Phoenix, Ariz., 147 ea., starter, pneumatic aircraft engine type STU-1/A, spare parts, ground support equipment and data for C-130 aircraft, (PRs EA-9-03J-4482; MO-9-03J-1211 and amendment no. 1), $265,901.

Vanguard III Plastic Casing

Lightweight plastic casing developed for the third stage solid propellant motor of Vanguard III satellite vehicle (AW Sept. 28, p. 32) is lifted easily by technician. Manufactured by the Young Development Division of Hercules Powder Co., the casing is made of glass filament reinforced plastic and is essentially the same as the unit used in the third stage of the earlier Thor Able III satellite vehicle which launched Explorer VI.

Biggest thirst in the universe

Each 6,000,000 pound thrust rocket ship now being planned for manned interplanetary exploration will gulp as much propellant as the entire capacity of a 170 passenger DC-8 Jetliner in less than 4 seconds! It will consume 1,140 tons in the rocket's approximately 2 minutes of burning time. Required to carry this vast quantity of propellant will be tanks tall as 8 story buildings, strong enough to withstand tremendous G forces, yet of minimum weight. Douglas is especially qualified to build giant-sized space ships of this type because of familiarity with every structural and environmental problem involved. This has been gained through 18 years of experience in producing missile and space systems. We are seeking qualified engineers and scientists to aid us in these and other projects. Some of our immediate needs are listed on the facing page.

Dr. Henry Ponsford, Chief, Structures Section, discusses valve and fuel flow requirements for space vehicles with Donald W. Douglas, Jr., President of DOUGLAS

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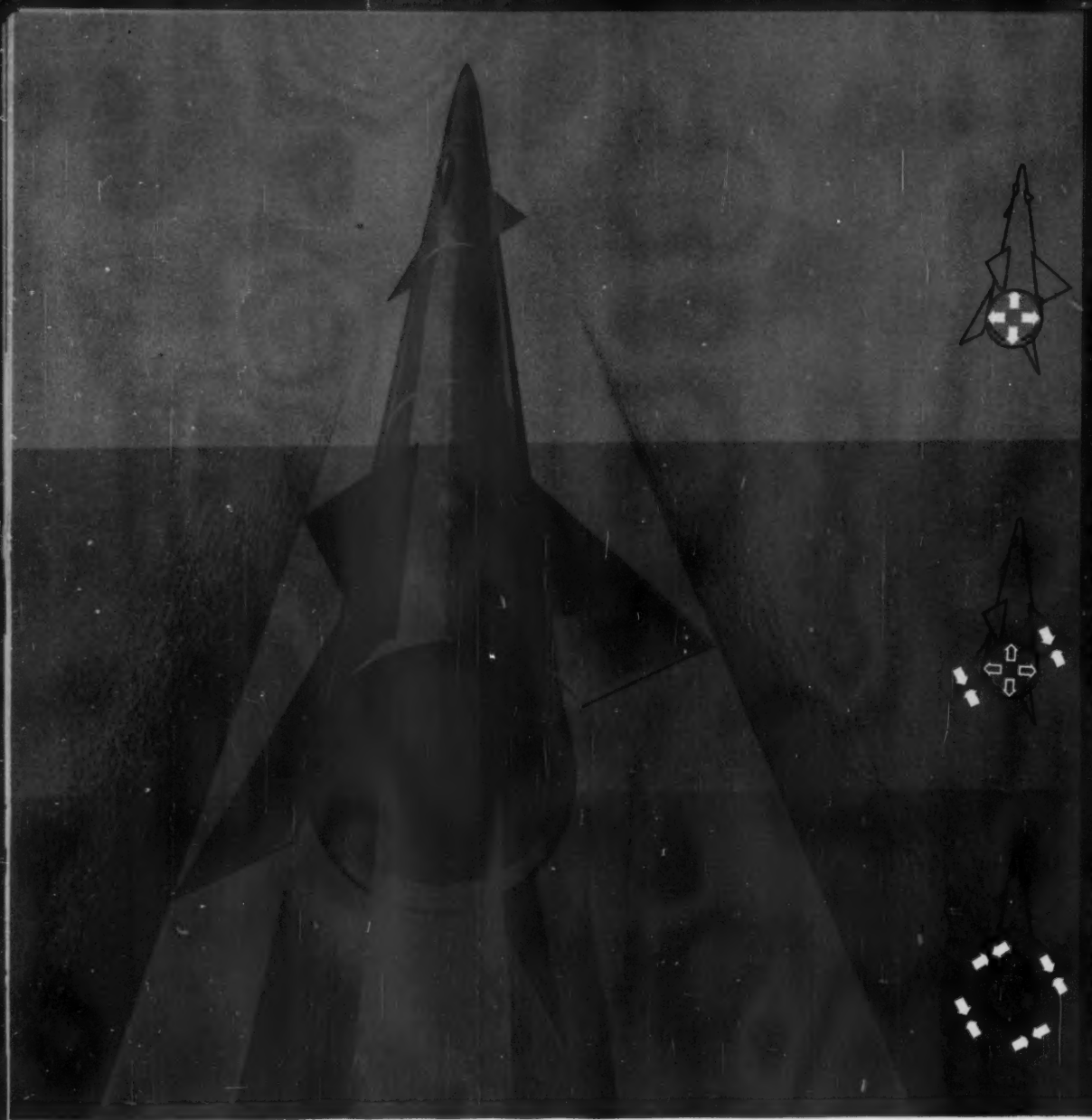

flight control for all environments

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Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Avenue, Philadelphia 11, Pa.

Malabar Manufacturing Co., San Leandro, Calif., parts kits for various aviation jacks, N383-60596A, 383/261296/59), various, $203,235.

The Massillon-Cleveland-Akron Sign Co., Massillon, Ohio, tow targets, Aerno 35, nylon banner, radar reflective, N383-60136A, (JD-IFB-383-864-59), 5,404 ea., $804,818.

Industrial Brownhoist Corp., Bay City, Mich., masts, airship mooring, type V, N383(17)605559A, (PREN 11-450-59), 4 ea., $511,454.

Telephonics Corp., Huntington, N. Y., microphone assemblies for oxygen smoke masks, N383-60653A, 383/232407/59), various, $38,048.

Collins Radio Co., Cedar Rapids, Iowa, R. T. tuners to support airborne radio communication equipment, N383-60685A, (383/231355/59), 1,874 ea., $41,678.

Telephonics Corp., Huntington, N. Y., microphone assemblies to support airborne communications systems, N383-60657A, (383/232759/59), various, $31,400.

Ware Brothers Co., Philadelphia, Pa., line, square halftone negatives and composites, N383(62767)-60914A, (JD-IFB-383-974-59), various, $60,000.

AC Spark Plug Division, General Motors Corp., Milwaukee, Wis., valves, plugs and shims to support fuel controls and switch assemblies on turbojet aircraft engines, N383-60710A, (383/256281/59), various, $43,291.

Worthy Chemicals, Inc., Brooklyn, N. Y., packets, shark deterrent, N383(MIS)-60913A, (JD-IFB-383-879-59), 39,701 ea., $59,154.

Air Logistics Corp., Pasadena, Calif., straddle type hoists for special support of various aircraft, N383-60917A, (IFB-383-890-59), various, $170,290.

Switlik Parachute Co., Inc., Trenton, N. J., life preservers, pneumatic, two flotation cells with breather valve, N383(MIS)-60592A, (MIPR-09-603-9-4220-193; MIPR-09-603-9-4220-280), 28,289 ea., $550,786.

Aviators Equipment Corp., Beacon, N. Y., life rafts, inflatable, one person capacity, N383(MIS)-60568A, (MIPR-09-603-9-4220-259), 9,279 ea., $407,534.

Curtiss-Wright Builds Sound Suppressors

An acoustical shell type sound suppressor has been developed by Santa Barbara Division of Curtiss-Wright Corp. Device is designed to eliminate all objectionable frequency noise.

The lightweight sound suppressor shell does not affect operation of the gas turbine, yet makes the unit inaudible at 200 ft. In the 6,800 cps. and 2,400 cps. frequencies, the new suppressor eliminates up to 85% of the noise and is equally effective in reducing low frequency noise.

Curtiss-Wright's South Bend Division presently is manufacturing ground runup exhaust suppressors of lightweight construction for U. S. Navy. Company has also developed an inlet noise suppressor for jet aircraft which eliminates the high-pitched whine of the compressor emanating from the front of the engine. Inlet suppressor can be used both as a flight unit and as a ground suppressor.

How Quaker Thermoid made ground-refueling hose to meet toughest government specifications

1. Developed a tube compound that can carry all aircraft fuels without showing appreciable signs of swelling or loss of adhesion to the carcass. A tube that withstands constant bending, twisting, and flexing without ply separation. Performs well in the range −40°F to +130°F.

2. Developed a tube reinforcement that is lightweight for easy handling and storage, yet able to withstand extremely high pressure without bursting. Resists weather, mildew, rot, and oil.

3. Developed an abrasion- and oil-resistant cover compound that protects the tube and reinforcement from damage when the hose is dragged over concrete aprons.

4. Completely bonded all component parts by an exclusive process of curing and manufacturing to provide a ground-refueling hose that is not only strong and easy to handle, but the safest ever built.

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Pod, measuring 8 x 16 ft. and weighing about 1,700 lb., is attached to S-60 airframe. Although first pod was a rush job built as an experiment, Sikorsky contemplates a future pod with a streamlined rear section. Front of the projected pod would attach to rear of cockpit. Note good visibility through cockpit rear windows. A heavy duty winch hook is attached to landing gear strut. S-60 lifting capacity is about six tons.

Sikorsky S-60 Demonstrates Pod Capabilities

Pod attaches at two points, fore and aft. Hooks (in position above left) support cabin weight, although two safety cables at each support (being attached) give fail-safe protection. At right, S-60 demonstrates towing ability by pulling an 18-ton Marine bulldozer through high grass at Ft. Belvoir. Aircraft is powered by two 2,100-hp. Pratt & Whitney R2800-CB5 piston engines.

AERONAUTICAL ENGINEERING

Sikorsky S-60 flying crane carries passenger pod aloft during Marine demonstration at Ft. Belvoir, Va. The two main wheels and two smaller castering-type wheels beneath pod are for ground maneuvering before hookup. Below, rapid troop unloading is demonstrated as 20 combat engineers exit through pod's five passenger doors. Troops sit on 16 bucket seats and four airline-type chairs inside.

CASE HISTORIES

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Army's Caribou Fuselage Lengthened

U. S. Army has taken delivery of the first three of five modified de Havilland of Canada DHC-4 Caribou short takeoff and landing transports purchased off the shelf in 1957.

Aircraft, redesignated YAC-1 Caribou upon Army acceptance, has undergone fuselage modifications aimed at increasing maximum gross weight from 24,000 lb. to 26,000 lb. since it was demonstrated in September, 1958, by de Havilland Aircraft of Canada, Ltd. (AW Sept. 29, 1958, p. 60).

Caribou fuselage has been extended 47 in., raising over-all length from 68 ft. 8 in. to 72 ft. 7 in., to achieve the 2,000 lb. gross weight increase.

The 8.3% gross weight increase somewhat reduces STOL performance of the higher gross Caribou, powered by P&W R2000 1,450-bhp. engines.

Under maximum load and zero wind conditions the differences are:

- **STOL takeoff roll** is 540 ft., a 10.2% increase.
- **STOL takeoff distance** to clear a 50-ft. obstacle is 1,020 ft., a 21.4% increase.
- **STOL landing roll** is 525 ft., a 23.5% increase.
- **STOL landing distance** to clear 50-ft. obstacle is 1,020 ft., 2% longer.

On the plus side, however, higher gross weights mean the Caribou will now carry:

- **Thirty-two fully-equipped** troops, instead of 28.
- **Twelve medical attendants** plus 14 litters, as opposed to 10 attendants and 14 litters before.
- **Eleven hundred and fifty** cubic feet of cargo, compared with 1,000 cu. ft. originally.

Last two aircraft in the Army order are scheduled for delivery next month.

The Caribou can fit into the Army's logistics chain by providing shuttle transport of troops and supplies from interior Air Force bases to front line dirt strips or unimproved fields, where cargo would be transferred to helicopters for delivery to battle positions.

De Havilland of Canada engineers have been working toward additional gross weight increases for the Caribou, chiefly through a more powerful engine, possibly a turboprop. Company has been studying a 1,920 eshp. turboprop currently under development as a possible future powerplant. This falls in the general class of the Lycoming T55.

Turbine engines for the Caribou, in addition to increasing gross weight, would also make possible the use of reversible pitch propellers. Caribou's present R2000 engines lack reversible props, although the company says landing performance is already good enough

U. S. ARMY accepted first three YAC-1 Caribous, takes delivery of last two in November.

PETAL TYPE cowling opens for engine access. Interior (below) has provision for 22 fully-equipped paratroopers or two jeeps for aerial delivery.

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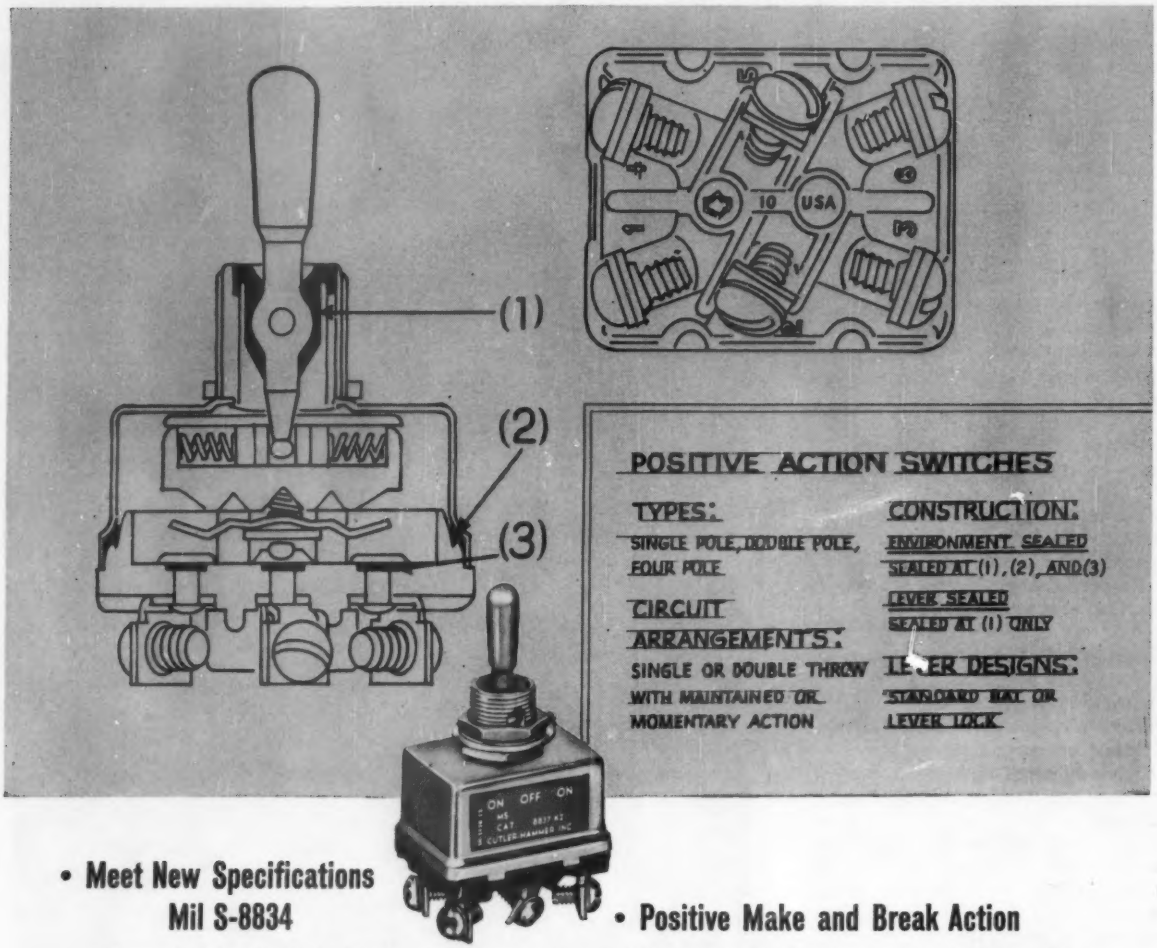

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to meet the STOL requirements the aircraft is expected to perform.

Caribou has been landed on unprepared, mowed farm fields in Canada, and STOL technique takeoffs and landings have been completed in distances averaging about 300 ft. into 7- to 10-kt. headwinds at full gross weight, the company said.

Thus far the company reports no troubles arising from the Caribou's 21-in. propeller ground clearance or from wheel clog in rough field landings. Larger diameter wheels have been studied as a measure to avoid possible rough-ground clogging, but de Havilland found a single-wheel configuration to replace the present dual wheel gear would increase the aircraft's weight by about 300 lb. per wheel.

Gear Designed For Rough-Field Landing

Columbus, Ohio—Battelle Memorial Institute is well along in the development of a landing gear system designed to enable aircraft to take off and land on rough and unprepared fields without bouncing.

Known as a high flotation system, the landing gear uses a low pressure tire with an automatic valve system that rapidly bleeds air from the tire upon landing to dissipate impact energy which could cause the aircraft to bounce.

Idea for the system was conceived by engineers of Fairchild Engine & Airplane Corp. which was awarded the prime contract for this research program by U. S. Army Transportation Corps.

Automatic deflation takes place through a sleeve valve that is controlled by the vertical load bearing down upon the landing gear. When the tire reaches a set minimum pressure, the valve automatically closes. Most of the Battelle work for Fairchild has been carried out with a tire in which the pressure can be rapidly reduced from 17 to 2 psi. upon landing.

Principal drawback to most low pressure tires, says Battelle, is that they must be considerably larger than conventional tires to bear comparable loads. To get around this, Battelle has been working with a thin, pliable tire specially fabricated from high tensile nylon and natural rubber. On takeoff, tire is automatically deflated before being retracted into the aircraft. The tire is then folded into a helical bellows to less than one fifth its inflated size. Just before landing, the tire is automatically re-inflated.

Original experimental system was designed to carry a static load of 750 lb. More recent system is being designed for 1,500 lb. static load capacity per wheel.

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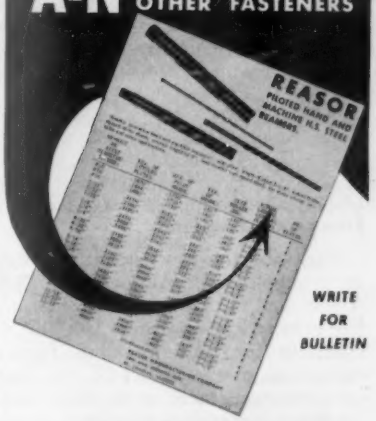

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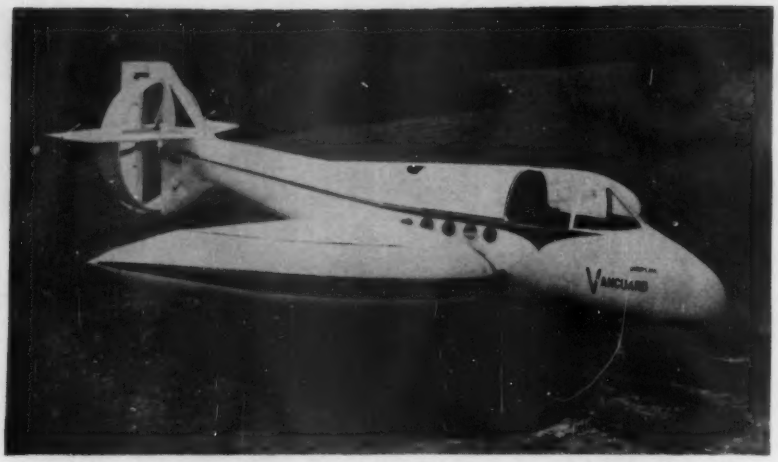


VANGUARD 2C fan-wings have upper lids installed. Lids are raised hydraulically during vertical takeoffs, closed for high-speed forward flight. Venetian blind type slats close the wing undersurface. Duct on tail pusher increases efficiency about 10%.

Business Version of Vanguard 2C Slated to Be on Market in 1962

Vanguard Air & Marine Corp. has scheduled its proposed four-place Model 8 VTOL aircraft for entry in the business plane market in 1962.

Construction of the Model 8 fan wing prototype, which would be Vanguard's first commercial version of its experimental two-place Model 2C (AW May 25, p. 129) will begin immediately, Vanguard President Edward G. Vanderlip told AVIATION WEEK.

Model 8 will be powered by twin 250-hp. Lycoming O-540-A1As supercharged to 380 hp., Vanderlip said.

Vanguard envisions its VTOL as a versatile, 200-mph. business plane capable of operating from company parking lots, providing point-to-point business air travel. Delivery might begin in March, 1962, at a tentative base price of $38,500, the company reports.

Top speed would be about 260 mph.

Financing Problems

Financing the new aircraft will not be a simple task. Although Air Research and Development Command has granted the company $60,000 in contracts for full-scale wind tunnel evaluations of the Model 2C test bed later this year, there as yet have been no firm commitments from the military which could absorb high prototype development costs.

Although Vanderlip founded his company as a private venture, an initial influx of outside capital has evolved with the sale of 26,000 shares of $1-par common stock in an issue closed out Aug. 20. Selling price was $6.50 per share, with all proceeds of the private placement accruing to the company, less legal and licensing fees. An additional 3,500 authorized shares were held unissued for internal use.

Vanderlip, former vice president and treasurer of Piasecki Aircraft Corp., reports current reserves should provide for about six months' operation. Capital already raised is reserved for Model 2C tests and development, he said.

To finance construction of the twin-engine prototype an additional 100,000 shares are scheduled for issue some time after Nov. 20. Unlike the first offering, which was privately placed, it will be underwritten for distribution. Company now has 180 shareholders, 24 of them presidents of Philadelphia-area corporations.

The additional capital will also be used to buy more plant equipment and to expand the present five-man engineering staff, AVIATION WEEK learned.

Model 8 design will be along lines similar to the Model 2C, which the company has been checking in ground trials at its Paoli, Pa., plant (AW Sept. 7, p. 119).

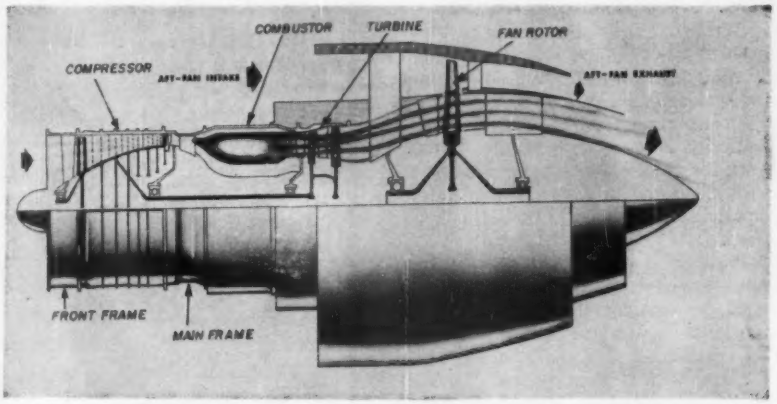
Runup Tests

In tests already completed the 2C's Lycoming O-540-A1A has been run up to full power and the aircraft's power train, wing fans and tail pusher propeller have been run up to maximum rpm. in a field alongside the company's plant.

Vanderlip, who has been in the cockpit during tests, reported the 2C seemed to be developing sufficient power and control response for the first tethered flight.

The 2C will be airlifted by the Air Force to Moffett Field, Calif., for full-scale wind tunnel tests, probably after the conclusion of ground tests in November.

Tests in National Aeronautics and Space Administration's Ames Laboratory 40 x 80 ft. wind tunnel there will include evaluation of lift and drag coefficients at speeds up to 100 mph., as well as hover and transitional flight studies.



Drawing Shows Airflow Through CF700-1

Small aft fan turbojet being developed by General Electric Co.'s Small Aircraft Engine Department, Schenectady, N. Y., is designated CF700-1 (AW Sept. 14, p. 39). The engine is basically a subsonic version of the J85 turbojet, mated to an aft fan unit. The engine is designed to be used as a powerplant for light and medium weight corporate or utility transports. Federal Aviation Agency certification is expected by early 1962. Takeoff thrust, sea level static, is 4,000 lb. Normal continuous thrust at 36,000 ft., Mach 0.8, is 1,020 lb. Average specific fuel consumption on takeoff, sea level static, is 0.69 lb./lb./hr. Normal continuous specific fuel consumption at 36,000 ft., Mach 0.8, is 0.97 lb./lb./hr. Engine weight is 585 lb.; weight of thrust reverser is 80 lb. Over-all maximum diameter is 33 in. and over-all length is 69 in.

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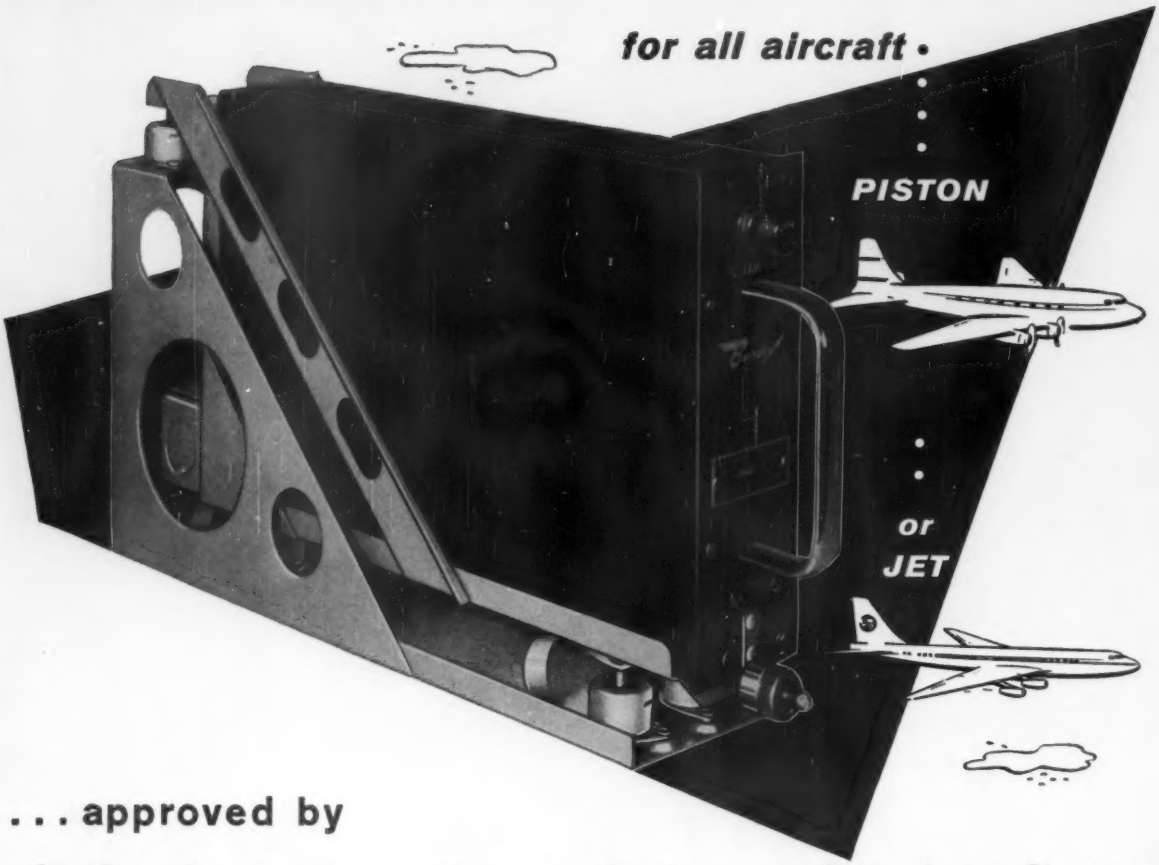

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Turbofan's Noise May Limit VTOL Use

New York—Turbofan lift engines for VTOL aircraft may not have as much noise advantage over turbojet engines as previously supposed, Harry Pearson, Rolls-Royce, Ltd., chief of research told the Seventh Anglo-American Aeronautical Conference here.

There may, however, be a weight advantage by using fans, he said, due to their lower fuel consumption despite higher engine weight, and in the future lift engines may account for only 6% of total airplane weight.

It has long been thought that turbojets would be impractical for VTOL lift devices, particularly in civil aircraft, he said, because of higher and therefore noisier jet velocities.

"The main object of the low fan-jet velocity is to reduce the noise level," Pearson said.

A sound level of 105 db. 200 ft. from a jet engine is almost intolerable, according to Rolls-Royce studies, he pointed out. To achieve levels in this 105 db. region jet velocity must be slowed to about 600 fps. he said, from the usual values of about 2,000 fps.

This involves the turbofan and the drawbacks accompanying it, such as higher engine weight, higher cost, and greater mounting complexity.

Furthermore, a noise reduction below 105 db. appears unlikely, for at jet speeds below 600 fps. compressor whine becomes the major noise component, and increases steadily upward from 105 db. as speed decreases, Pearson pointed out.

He said conventional jets operating at high jet velocities can be silenced to about 110 db. at speeds of 2,000 fps. Use of higher speed jets would also ease the problem of momentum drag arising from the high mass transfer of the large-diameter turbofan engine as it expels a large volume of relatively low velocity air downward.

This high momentum drag creates severe problems in transitional flight, Pearson pointed out.

The turbofan cannot be ruled out for VTOL, he said. Even though there appears to be little justification for the fan configuration on the basis of specific weight—pounds of engine per pound of thrust—or even on the basis of noise reduction, the fan still is more economical on fuel.

The weight of fan engine plus fuel for three minutes of full-powered lift appears to be less than for the lighter turbojet, he said. An optimum level seems to arise at a fan jet velocity of about 600 fps.

Strongly in favor of multiple engine clusters of jets for VTOL applications, Pearson cited the advantages of a com-

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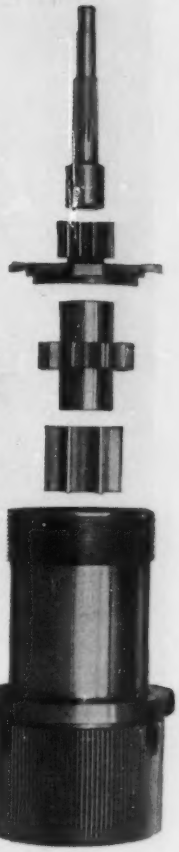

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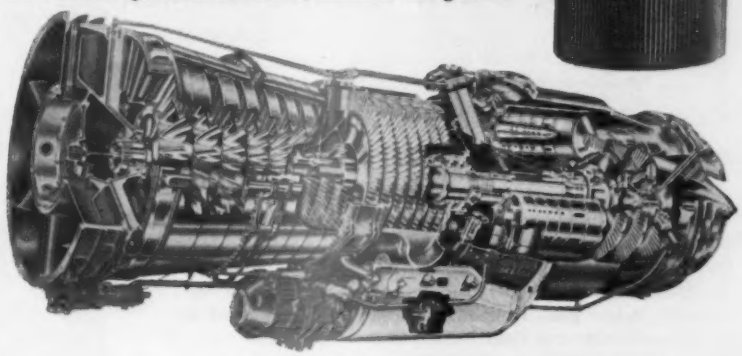

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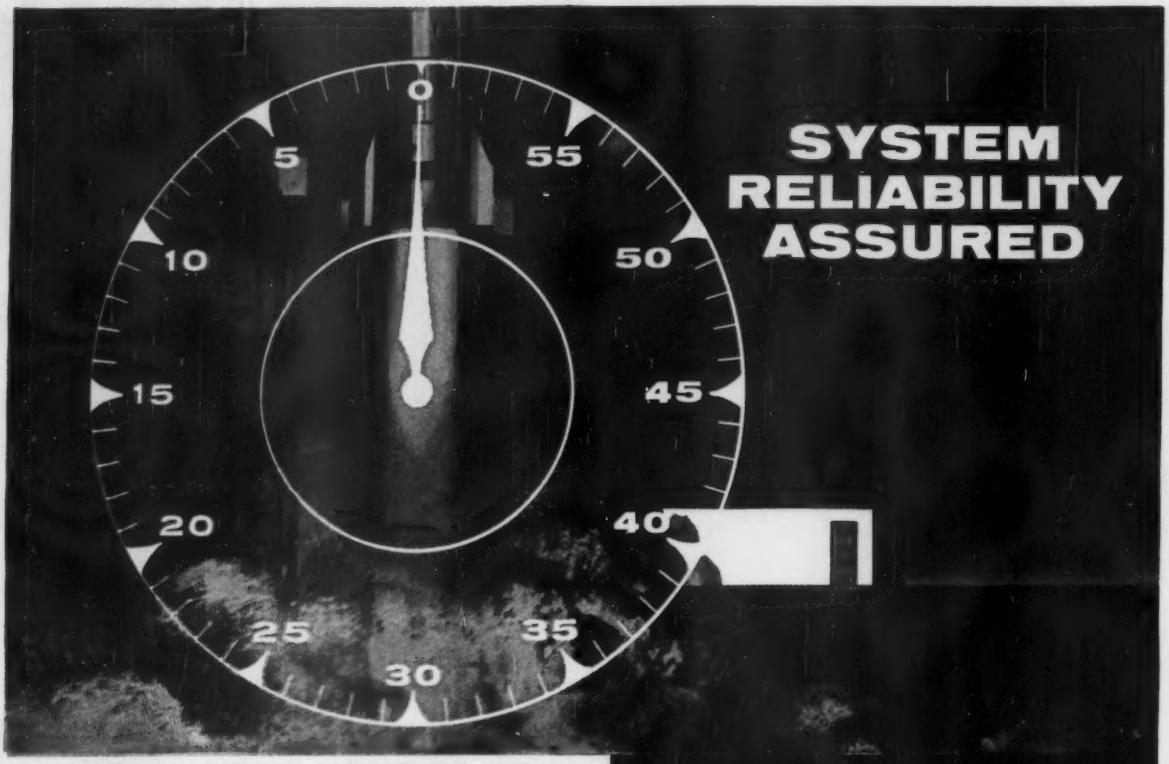

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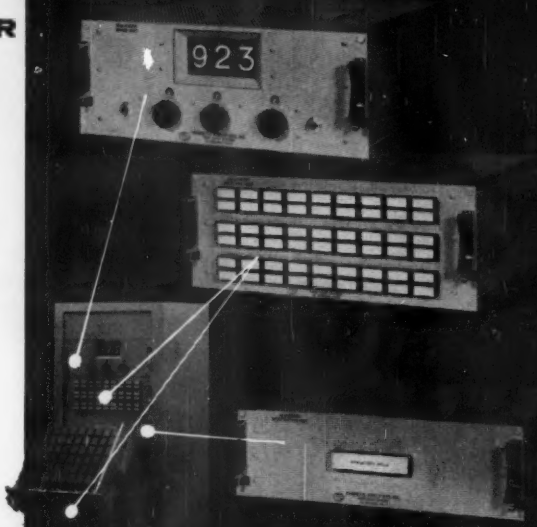

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mon fuel system and the fact that clustered engines lower the noise level somewhat. The most promising methods of control during vertical flight appear to be with either rocking the engines to and fro to achieve directional stability, or with bleeding away thrust to control jets on the aircraft's extremities, he said.

By designing small, lightweight engines, specific weights on the order of 0.06 lb. per pound of thrust can be achieved, he said, making lift engines account for only about 6% of total aircraft weight. Pearson said it is expected this 0.06 specific weight can be achieved on engines up to 5,000 lb. thrust.

He offered a possible turbofan VTOL engine design which would provide both lift and propulsive thrust. The engine would have a free turbine which feeds air to the lifting fans during lifting. If needed, this air could be heated by igniting fuel. The turbofan engine would feed four lifting fans of about 26 in. diameter.

For forward propulsion, air would be diverted from the fans to a jet nozzle.

Specific consumption would be about that of a bypass engine, he added. Total lift would be about 7,000 lb. with a fan outlet velocity of 580 fps. Estimated weight of the engine would be about 1,500 lb., giving a specific weight of about 0.21.

In forward propulsion static thrust of the proposed engine would be about 3,000 lb., he said.

Engine clusters would be placed on the airframe so engines could be pivoted or exhaust deflected to produce pitch and roll control during lifting. Fans would be in the wings or fuselage.

One possible refinement, Pearson said, would be to duct compressor air to a jet-flap or blown-flap configuration, thus lowering transition speed.

Unlike Pearson, who felt that one of the chief attributes of the fan for VTOL was noise reduction, two General Electric engineers have urged the use of afterburner equipped fans for VTOL propulsion and lifting.

Neil Burgess and A. P. Fioretti of the Flight Propulsion Division told a meeting of the Society of Automotive Engineers at Los Angeles that an efficient VTOL aircraft might use separate ducted fans for takeoff and cruise, with energy supplied from a common gas generator, or by a direct connection with a turbine shaft.

Convertible systems such as these could use a single basic propulsion unit to give high thrust lift for takeoffs and good propulsive efficiency for high subsonic cruise, they said.

The authors disagreed with those who eliminate ducted fan from consideration for supersonic aircraft propulsion because of its poor propulsive efficiency at high speeds. Ducted fan can offer the high takeoff thrust needed for a supersonic transport as well as a more acceptable noise level than afterburning turbojets.

For the same dry takeoff thrust an afterburning turbofan could provide many times the thrust of the afterburning turbojet because of the large quantities of air available for combustion in the afterburner.

However, this could be achieved only by accepting a loss in specific fuel consumption, they said. An afterburning ducted fan should probably be operated at a small percentage of the total afterburner thrust available—the engine could then be sized to provide the same cruise thrust as an afterburning turbojet while supplying greater takeoff thrust at lower specific weight.

Specific fuel consumption of turbofans with partial afterburning should be lower than that of the full afterburning turbojet. A fan engine could be run with more complete afterburning during climb to improve block speed and fuel economy by reducing climb and acceleration time.

Ducted fans will offer such secondary advantages as low fuel consumption in holding patterns and increased life and reliability due to lower operating temperatures.

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Airwork sells and uses only genuine Pratt & Whitney Aircraft parts . . . and inspects the parts of your incoming engine to make sure somebody hasn't short changed you with a bogus part on maintenance . . . or a previous overhaul.

The difference between a genuine part, with all the stamina and service-ability the manufacturer can develop—and a dangerous bogus part is sometimes so hard to spot that only a distributor with close factory connections has the training to spot the true from the false.

That's one more good reason to have your engines overhauled by Airwork. You are sure of getting genuine parts, careful craftsmanship and the painstaking protection of our eagle-eyed Airwork inspectors. Call or write our nearest branch office for details.

Airwork CORPORATION
Millville, New Jersey

ATLANTA NEWARK
CLEVELAND NEW YORK
MIAMI WASHINGTON

Airwork

be sure, be safe with

TWIN LOCK TERMINAL BLOCKS

Twin Lock terminal blocks offer the ultimate in terminal reliability, speed of assembly, and versatility of application. Molded of a lightweight phenolic base with reinforced barriers between cavities, the Twin Lock block will accommodate up to 40 connections quickly and surely. Twin Lock's exclusive, insert-and-tighten two-way locking action cuts harness assembly time to a fraction of that required by any other block. Twin Lock contact points, either tin plated, gold plated or plated to customer specification, assure lowest resistance connection. Wire end connectors, compatibly plated, can be supplied for manual or automatic assembly. Available in either vertical or side entry types, the Twin Lock block is applicable wherever a fast, positive, reliable electrical connection is required. For complete information on these remarkable new blocks, write for the T-1000 and T-1010 Terminal Block Brochure.

SIMPLE
The terminal connector, crimped onto the wire end, slips easily into the block cavity. No screws or washers to remove, nothing to drop, just insert it.

SPEEDY
When connectors have been inserted, they're locked electrically and mechanically. Then, when the circuits have been checked, a few quick turns of the lock screw and they're double-locked.

SURE
When the connector has been inserted and tightened, the Twin Lock terminal block connection is positive—electrically and mechanically. Over 100 lbs. force is required to break this connection.

TWIN LOCK INCORPORATED

1024 West Hillcrest Blvd.
Inglewood, California

Coliseum Tower, 10 Columbus Circle,
New York 19, New York

PRODUCTION BRIEFING

Garrett Corp., Los Angeles, has established Garrett International with headquarters in Geneva, Switzerland, to conduct overseas business. The international subsidiary will conduct all business with Garrett customers outside the North American continent.

Illustrated Publications Service, Dallas, Tex., will produce some 41,000 pages of Convair B-58 technical handbooks under a $227,000 contract from Convair-Ft. Worth.

Filters, Inc., Milpitas, Calif., will supply Fiberglas filter elements for filtering jet fuel from aircraft carrier storage tanks. Filters remove solid contaminants and sea water from the fuel. Sea water is used for ballast as fuel is removed from tanks.

Follow-on subcontracts, exceeding $500,000, have been awarded Temco Aircraft Corp., Dallas, Tex., by Lockheed Aircraft Corp.'s Marietta, Ga., Division. Work covers C-130 Hercules components, will continue this production at Temco through the summer of 1960.

Grumman Aircraft Engineering Corp. has ordered vacuum brazing equipment from F. J. Stokes Corp. for use in the fabrication of stainless steel honeycomb panels for the Eagle missile. Equipment will be capable of brazing panels larger than 50 sq. ft.

Bids for construction of nine more Atlas intercontinental ballistic missile launch sites near Cheyenne, Wyo., will be opened by U. S. Army Corps of Engineers about Nov. 4. Project will cost between $20-30 million. Sites will be single-launching pads. Atlas Site A, about 20 mi. northwest of Cheyenne, contains six launchers and is nearly completed.

Chance Vought Aircraft, Inc. has received a $9.5 million Navy contract for modernization of 147 early-model F8U-1 fighters and 17 F8U-1P reconnaissance aircraft. Program will extend through February, 1961, with the aircraft going through the modernization line at a rate of 11 per month.

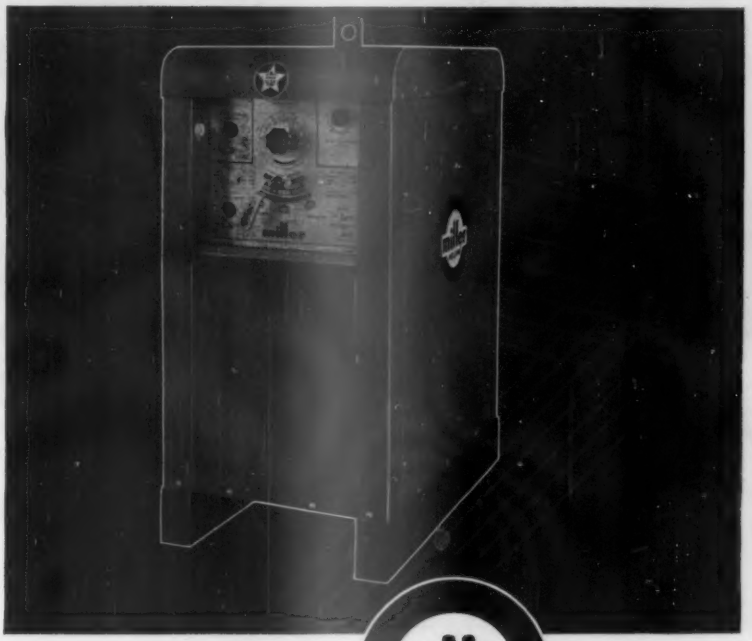
Republic Aviation expects to chart future plans by studying growing civil and military markets with creation of an Economic Research and Corporate Planning Division. Director of the new division will be Republic Chief Economist Edward Stone.

Boeing B-52E and B-52G altitude capability is in the vicinity of 60,000 ft., Air Force has announced. A B-52 has reportedly run engine tests at altitudes slightly over 59,000 ft., remaining above the 55,000-ft. mark for about 58 min.

Electro-Optical Systems has received $93,094 contract from Air Force's Wright Air Development Center for research and development of advanced power systems for outer space application.

Douglas Aircraft Co. has combined into a single organization its Santa Monica and Long Beach engineering departments to be known as Transport Aircraft Engineering. No large-scale shifts in location of personnel are planned. Combined organization will have headquarters in Santa Monica, will assume engineering responsibility for transport programs, both military and commercial, under direction of E. F. Burton, vice president-transport aircraft systems.

Sud Aviation has received an order for four Caravelle twin turbojet transports from Alitalia, the Italian national airline. The first Alitalia Caravelle is scheduled to go into service next April. The airline also took an option on four additional Caravelles, as predicted by AVIATION WEEK (AW Sept. 21, p. 33).



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....becomes evident after sufficient exposure to the original cost/maintenance costs/production/profits equation.

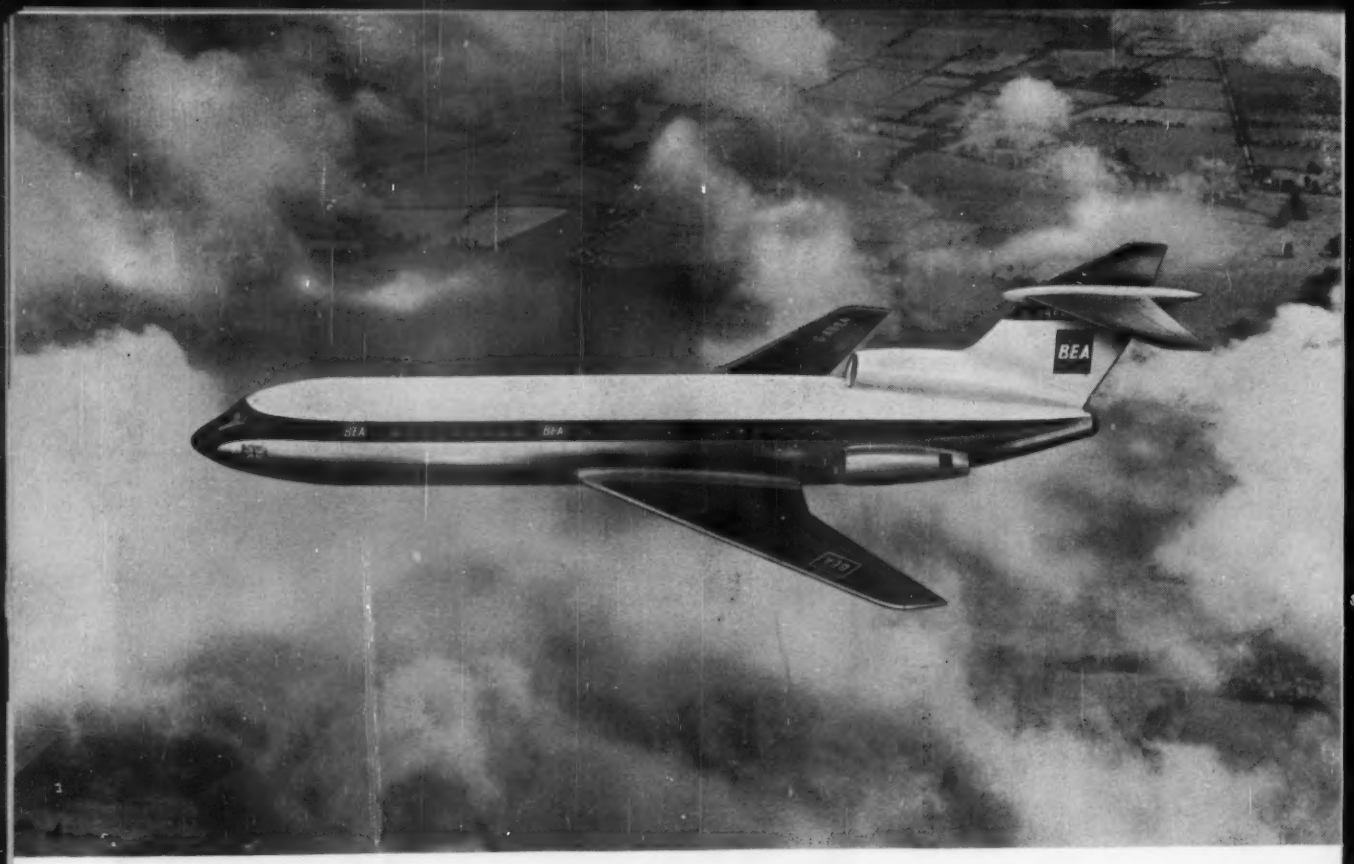
Exploiting the full potential of better basic design, the Miller Gold Star 300 series ac-dc welders convert in minutes from the prime ac-dc welder of exceptional performance to any of these three A-C applications: Metallic Arc, manual or automatic Inert Gas; or, to any of the following D-C applications: Metallic Arc, manual or automatic Inert Gas, or Inert Gas spot welding.

It's important to note that the Miller conversion kits utilized to obtain any of the above simply extend the built-in superiority of the 300 series' welding characteristics into the type of application desired. It's adaptable by design — not discovery.

Available in 200, 300, 400 and 600 ampere models, all feature the exclusive Miller transformers and semi-metallic rectifiers. Complete specifications, including duty cycle chart, will be sent promptly upon request.

miller ELECTRIC MANUFACTURING COMPANY, INC., APPLETON, WISCONSIN

• Distributed in Canada by Canadian Liquid Air Co. Ltd., Montreal



AIRCO D.H. 121

(Rolls-Royce RB163 by-pass jet engines)

The ultimate 600 m.p.h. airliner for economical short-haul operations from 1963

Duty	Intended to replace Viscounts and Convair liners on regional networks with stages up to about 1,200 statute miles, *1920 km.*
Speed	The ultimate in sub-sonic speed. Maximum cruising speed is 606 m.p.h., *970 km/hr.*—M.O.875 at 25,000 ft., *7620 m.*
	Speed for best operating economy is 585 m.p.h., *936 km/hr.* — M.O.87 at 32,000 ft., *9753 m.;* this is faster than claimed for any other commercial jet.
Economy	A.T.A. cost per seat mile 1·04 cents, assuming 900 miles stage with 97 economy-class seats.
Size	Capacity is designed for expected increases in traffic and frequency in the 1960s and onwards.
Turnaround	Able to operate stopping services without intermediate refuelling.
Airfield Performance	Able to use, with full load, runways less than 6,000 ft., *1829 m.* long. Docile handling. Will have automatic landing for safe all-weather operation.
Engines	Three Rolls-Royce RB163 by-pass jets, each 10,100 lb. thrust. Efficiency with reliability.
Quietness	Rear-mounted engines with jet-noise suppressors give exceptionally quiet cabin, an exterior noise no more than present propeller-driven short-haul liners.
Experience and Resources	Combination of unequalled experience in jet-airliner development and high-speed flight, with formidable industrial resources.

AIRCRAFT MANUFACTURING COMPANY LIMITED

Hunting *de Havilland* *Fairey*

AIRCO

NEW AVIATION PRODUCTS

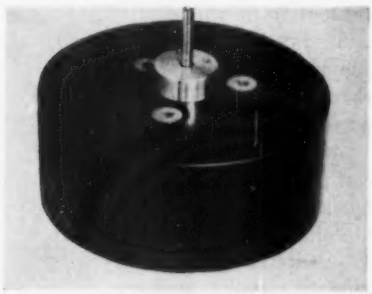
Aircraft Generator Truck

Self-propelled generator unit supplies turbine or reciprocating aircraft with 60 cycle or 400 cycle a.c. power with an additional d.c. power source. Vehicle is powered by a General Motors diesel or a Chrysler industrial engine which powers the generator and propels the unit. The 48 in. height of the vehicle permits operation close to the aircraft. Vehicle is available with or without an enclosed cab, as a towed cart or in conjunction with a tow tractor. Manufacturer is Stewart & Stevenson Service, Inc., Houston, Tex.

Synchronous Motor

Precision hysteresis synchronous electric motors are intended for missile and aircraft instrumentation, computer drum drives and flow meters.

Motor-induced flutter will not exceed 0.1 rms. at 1,200 rpm. or 0.15 rms. at 360 rpm. while stray external magnetic field with a normally shielded head is



held to −47 DBM. Ambient temperature range is from −32 to +135C, with broader ranges available.

The motors are insensitive to line or power supply voltage variations and utilize an axial air gap design which provides a precision drive with simplified construction.

Hysyn Electromotive, 915 Citrus Ave., Los Angeles 38, Calif.

Hot Gas Relief Valve

Relief valve for hot gas systems up to 2,000F is constructed entirely of stainless steel. Valve controls pressure in solid propellant gas generator systems.

Model 2200 valve's cracking pressure is adjustable from 1,000 to 15,000 psi.; hysteresis is less than 5%. Poppet design eliminates valve chatter. Mass flow capability is greater than 0.015 lb./sec. at 1,000 psi. Unit mounts on MS-33656-4 fitting and weighs 2 oz.

Pyronetics, 11937 E. Slauson, Santa Fe Springs, Calif.

Servo Valve Amplifier

Servo valve amplifier is designed for proportional control of hydraulic transfer valves in missile and aircraft guidance systems. Output is 8 ma d.c. push-pull

RESEARCH AND DEVELOPMENT ENGINEERS AND SCIENTISTS

Exceptional opportunities in the field of thermodynamics.

At least five years experience or training required. Must have knowledge and understanding of theoretical, experimental work and ability to direct activities of engineers in the following areas:

Aerodynamics Heating of Aircraft Structures

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Thermodynamics—Engineering, Chemical, Statistical

Heat Transfer

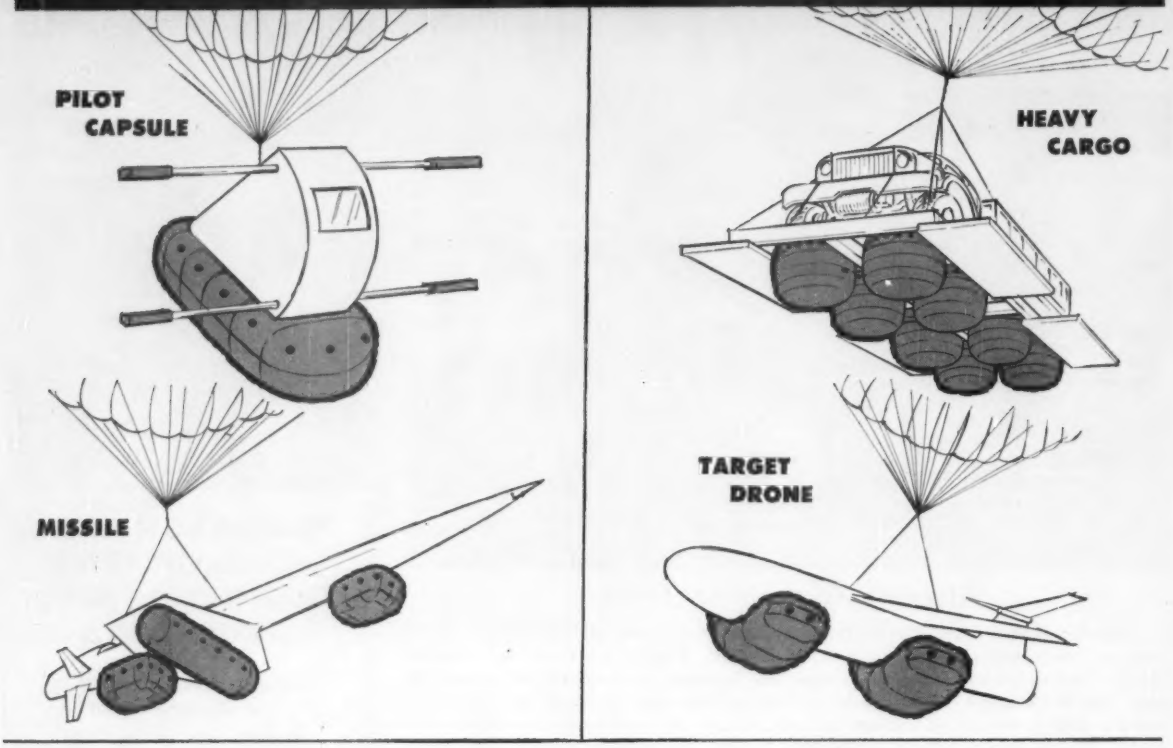
Gaseous Radiation

Hypersonic and Space Vehicle Design

For more information please write to: Mr. A. K. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

THE LOS ANGELES DIVISION OF
NORTH AMERICAN AVIATION, INC.

PNEUMATIC RECOVERY SYSTEMS / another product of Air Cruisers research



Solve New Missile and Capsule Recovery Problems

Air Cruisers has nearly a decade of experience in the development, testing and production of pneumatic recovery systems. Beginning with aerial cargo recovery, the company expanded its activities to include deceleration systems for various missile and target drone applications.

Other Air Cruisers system designs include recovery of missile nose cones and component parts, and pilot capsule recovery which enables the crew to land safely in the sealed capsule.

Air Cruisers' recovery systems consist of inflatable deceleration and/or flotation bags specially designed to meet all requirements:

- Provide maximum protection from landing damage
- Insure uniform deceleration
- Limit maximum "G" loadings
- Insure complete protection at normal drift and oscillation attitudes
- Provide dependable and adequate buoyancy for water recovery

With these rugged impact bags, you may have your choice of inflation methods, including the proved jet pump method to save added weight and space. Air Cruisers starts with your problem statement and can furnish the complete system. Write for full information concerning pneumatic recovery systems.

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AIR CRUISERS DIVISION

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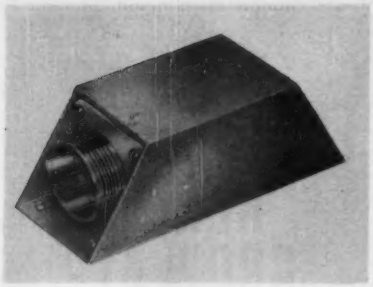
LIFE JACKETS • LIFE RAFTS • HELICOPTER FLOATS • ESCAPE SLIDES • GAS BREATHER BAGS • DECELERATION BAGS



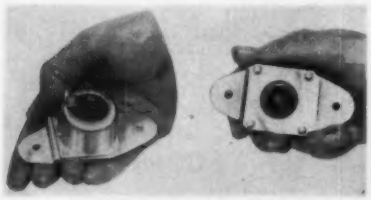
into two 1,400 ohm loads; control signal is 0.5 to 2.0 v.d.c. into 3,000 ohm load. Amplifier is 4 in. long by 1¼ in. square and weighs 8 oz.

Vickers Inc., Electric Products Division, 1815 Locust St., St. Louis 3, Mo.

Wing Light Mounts

Metal vibration and shock control mounts are designed for wing tip lights on military and commercial aircraft. Mounts are in use on the Boeing B-52 bomber.

Model K1092 mounts isolate vibration which produces changes in the reflecting surfaces of directional bulbs, and provides an anti-rotation feature



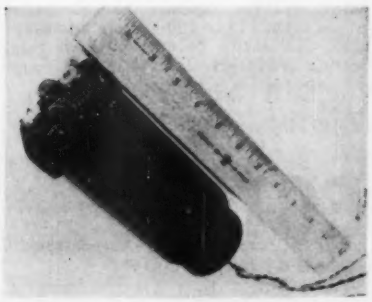
which assures socket stability during installation and removal of bulbs. Isolation also minimizes filament failure, thereby reducing maintenance cost. Metal mounts for tail lights, landing and taxi lights are available.

Robinson Technical Products, Inc., Teterboro Air Terminal, Teterboro, N. J.

Marker Beacon Receiver

Transistorized marker beacon receiver is set for standard beacons at 75 mc. plus three audio modulation frequencies which illuminate one of the three light indicators.

The unit is 2¼ in. in diameter, 7½ in.



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IS FLIGHT REFUELING, INC.

Integrated facilities for the study, development, testing and manufacturing of lightweight systems, sub-systems and components.

FAST FLUID TRANSFER SYSTEMS

(LOX, N_2, Hg, JP Fuels, H_2O_2, Heated Gases)

Air to air, ground to air, ground to ground, sea to air, sea to sea . . . from Av-gas to nuclear coolants. Accomplishments include ground fueling of Thor missiles and ship-to-ship refueling at sea.

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FRI's years of designing and manufacturing Probe and Drogue Refueling Systems for all types of aircraft have resulted in the most advanced techniques in this specialized field.

CONTROLLED AIRBORNE SUSPENSION SYSTEMS

Suspension of various objects from airborne bodies. Projects include high speed target towing systems, trailing of dipping sonar systems, cable-laying cartridges and fire-fighting packages.

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Mechanisms for automated control rod actuation, valving and other fluid control in all types of installations. Automated fueling and defueling devices.

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Complete facilities for production of sub assemblies and components to military specifications and environmental testing to MIL-E-5272.

Government and industrial contracts as scheduled and within budget limitations. Write for illustrated literature.

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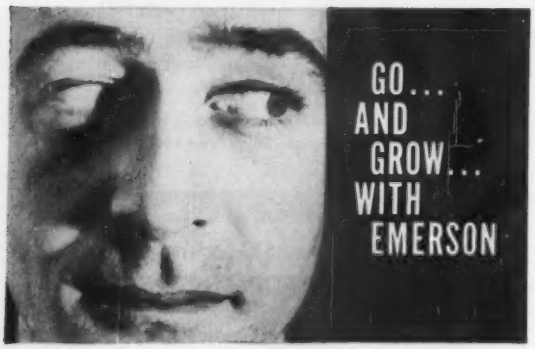
West Coast Representative: William E. Davis, Box 642, Inglewood, Calif.
Denver Representative: Price Engineering Sales Associates, Box 421, Littleton, Colorado



Engineers are a hardy breed . . . and the right *growing* conditions can make them flourish far beyond expectations.

Emerson Electric provides the most "fertile soil" available. Proof? So many of our engineers have come so far in so few years, with a research and development staff that is one of the finest in the entire industry.

We owe this achievement to many important considerations . . . not to a magic "green thumb". We provide our engineers with elbow room, they're not bogged down with non-technical details. Encouragement of original ideas, an unusually cooperative and close spirit, elimination of formalities . . . these and other factors are *real* at Emerson.

It has paid off exceedingly well for engineers and company alike: Emerson has grown from $45 to $90 million annually in just five years! *You* can easily become part of this "garden spot" for growing engineers. Just write us today for an interview at our expense.

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- RADAR SYSTEMS ENGINEERS
- SERVO ENGINEERS
- COMPUTER ENGINEERS (analog & digital)
- ELECTRONIC SUPPORT EQUIPMENT DESIGN ENGINEERS
- INFORMATION THEORISTS
- COMMUNICATIONS SYSTEMS ANALYSTS
- RELIABILITY ENGINEERS
- TECHNICAL WRITERS (electronic background)

Emerson needs individuals who can make significant contributions in an initial stage concept-oriented program. Assignments in our radiation division, for example, involve radar development, parametric amplifiers, electronic scanning and complete radar fire control systems.

We emphasize the systems approach, which means Emerson engineers explore and contribute in many diversified areas. This climate of creative freedom has paid off in solid achievements.

If your talents can be better utilized by assuming greater responsibilities, you owe it to your future to contact us at once.

Send complete resume to R. L. Middleton.

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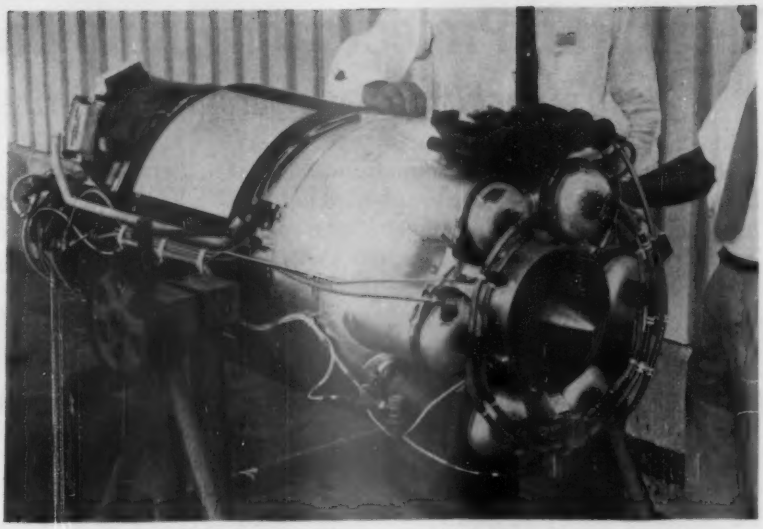


Turbine Starts B-58 Engine

Turbine engine provides pneumatic starting for the Convair B-58 bomber. Mounted on a start cart, the turbine produces 210 lb. of air per minute at 75 psia. Starting unit will start two of the aircraft's J79 engines in 30 sec., and all four engines in one minute precluding the necessity of cross bleeding air. Manufacturer of the turbine is the AiResearch Division of the Garrett Corp.

deep and weighs 16 oz. Power consumption is: 13.75 v.d.c. at 0.25 amp. Audio output is 1 v. at 500 ohms when simultaneous visual is desired. Antenna impedance is 52 ohms. The price of the receiver is $295.

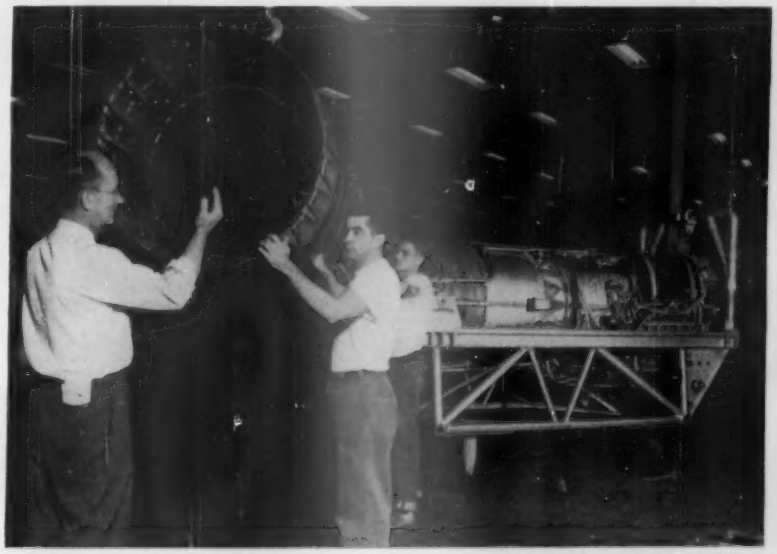
Twenty First Century Electronics, Inc., P. O. Box 2326, Riverside, Calif.

Rocket Control System

Hydraulic engine control, operating at 3,000 psi., accepts electrical and pressure signals and controls flow to six interior ports and two manifolded servo valves by means of five slide valve assemblies. Also included are a manifolded accumulator, a system filter, four filters to protect the servo valves, three control orifices and two check valves.

One of the slide valves is operated by a pressure-operated pilot section.

Hydraulic Research and Manufacturing Co., 2835 N. Naomi St., Burbank, Calif.



J79 Destined for West German Air Force F-104

Afterburner tailcone of General Electric J79-7 turbojet is removed from the gas generator for shipment to Lockheed Aircraft Corp. for installation in an F-104 fighter to be delivered to the West German air force. Components are shipped in steel canisters.

These R&D Projects for Future Decades in Space

typify Lockheed's vast program of Air/Space Science

■ New programs and study contracts awarded to Lockheed's California Division are planned to solve America's future exploration projects into space. The new multimillion-dollar Research Center in nearby San Gabriel mountains is further evidence of Lockheed's determination to support and supplement its already extensive research and development activities.

As a result of this markedly expanded program, there is urgent need for engineering and scientific personnel with high-level technical skills.

Long a leader in advancing the science of flight, Lockheed is placing vast resources and accumulated knowledge into programs designed to provide major break-throughs in the fields of: Basic and applied research; manned aircraft of advanced design; missiles and spacecraft. Some of these important research and development programs are:

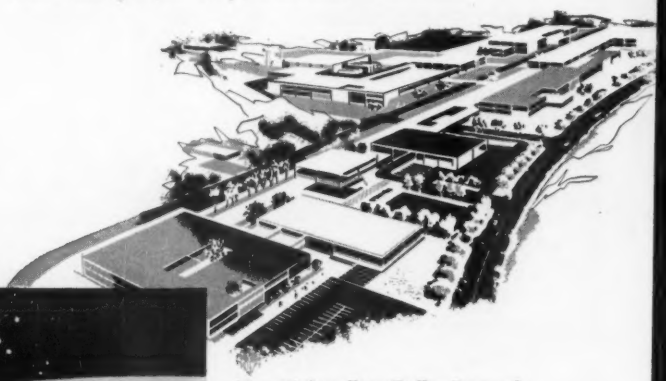
High Altitude Flight Vehicles with speed range between Mach 8 to 25. Problems associated with landing **Manned Space Vehicles** capable of hypersonic glide or orbit about the earth. **Infrared System** studies as an advanced method of detecting ultrasonic missiles and high-speed aircraft. **Solar Radiation** studies. **Vertical Take-Off and Landing** and "air recovery" vehicles. **Helicopters. Supersonic Transports.**

High caliber scientists and engineers are invited to investigate Lockheed's outstanding career opportunities. Openings now exist in: Aero-thermodynamics; propulsion; armament; electronics—research and systems; servomechanisms—flight controls; sound and vibration; operations research; physics; antenna and telemetry; and underwater sound propagation.

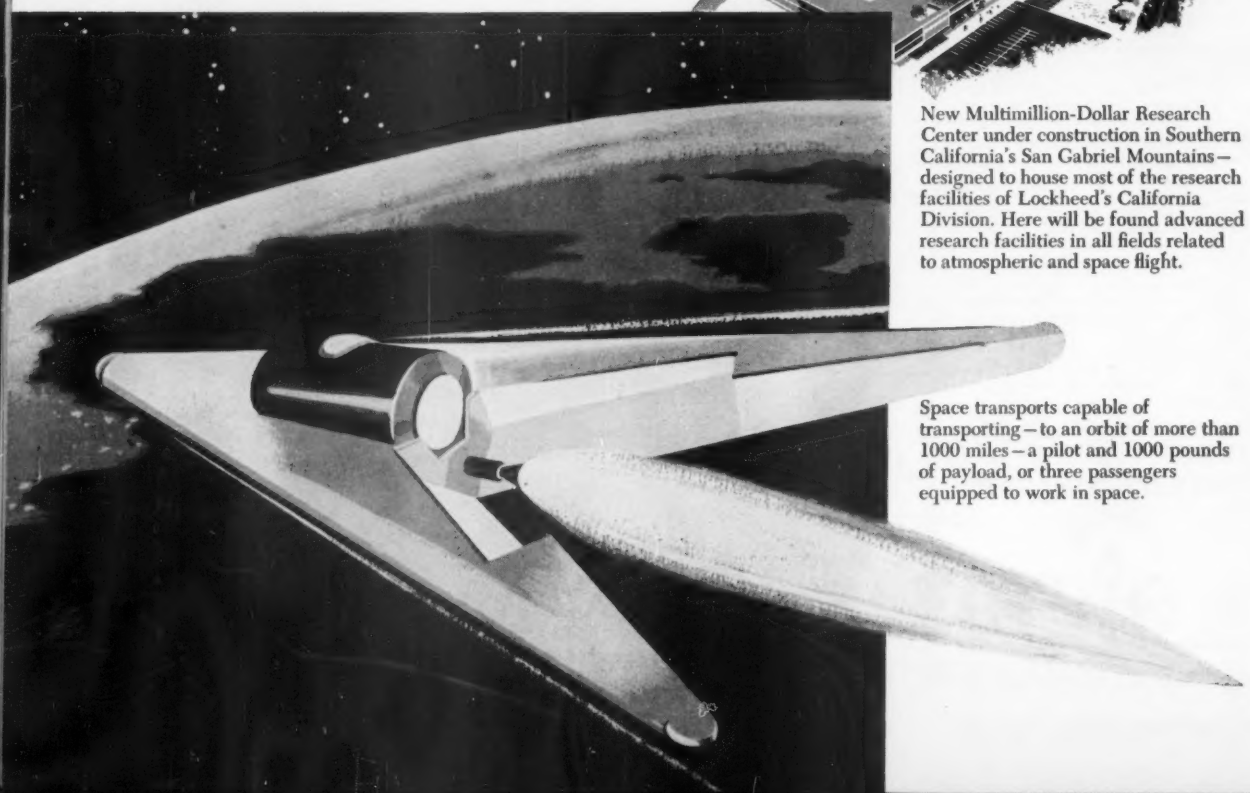
Write today to: Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 11102, 2400 North Hollywood Way, Burbank, California.

LOCKHEED

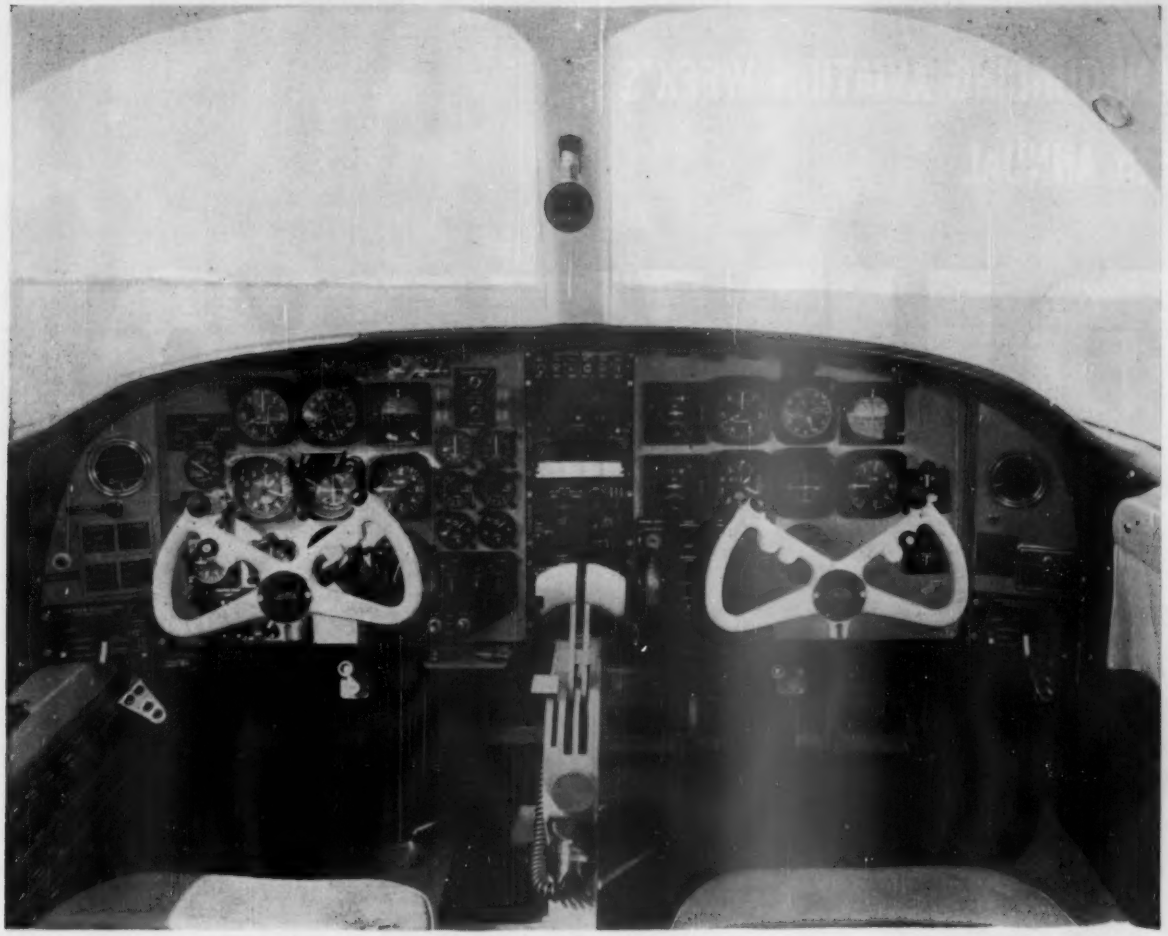
CALIFORNIA DIVISION
BURBANK, CALIFORNIA



New Multimillion-Dollar Research Center under construction in Southern California's San Gabriel Mountains—designed to house most of the research facilities of Lockheed's California Division. Here will be found advanced research facilities in all fields related to atmospheric and space flight.



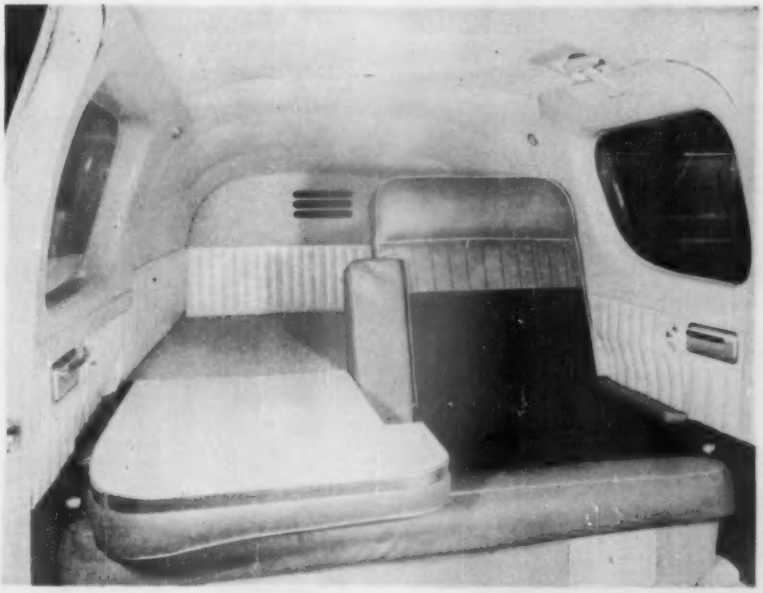
Space transports capable of transporting—to an orbit of more than 1000 miles—a pilot and 1000 pounds of payload, or three passengers equipped to work in space.



Cessna 407 utility jet cockpit mockup shows conventional business plane layout. Engine instruments are left of center, warning lights at extreme left.

Mockup Shows Interior Layout of Cessna 407

Mockup of Cessna's 407 utility jet (AW Sept. 28, p. 41) foretells a possible sales effort aimed at the business flying market. Aircraft has wheel-type controls, luxury interior and a conventional business airplane cockpit differing widely from the Cessna T-37A from which it evolved. Cessna Aircraft Co. would probably wait for a firm military commitment before building a flying prototype; however, a civil version might sell for about $200,000 which would price it competitively with Beechcraft's imported MS 760 four-place executive jet. Powered by two Continental J69-T-29 engines rated at 1,400 lb. thrust each, Cessna Model 407 would have a maximum cruise speed of 404 kt. (465 mph.), service ceiling of 46,400 ft., 3,680 fpm. rate of climb, and maximum range of 1,380 naut. mi. Stall speed at 9,300 lb. maximum gross would be 84 kt. (idle rpm. with landing flaps at sea level). Up to 160 lb. of baggage can be stowed behind rear seats, which also fold forward (right) for stowing bulky loads.



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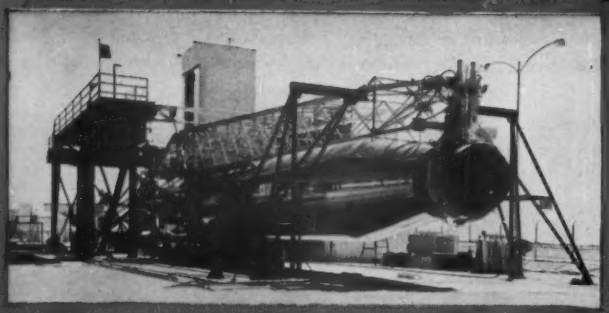

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SERVING THE ENTIRE AVIATION INDUSTRY
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GUIDE ISSUE

THE STANDARD PURCHASING REFERENCE OF THE INDUSTRY
LISTING OVER 50,000 MANUFACTURERS' PRODUCTS IN
OVER 1,800 SEPARATE PRODUCT CATEGORIES

Day after day, engineering-management people review AVIATION WEEK'S ANNUAL BUYERS' GUIDE in their search for new sources of supply for products, materials and services. AVIATION WEEK'S BUYERS' GUIDE is the industry's recognized buyers' guide covering all segments of the $11 billion aviation industry and its related technologies.

The new 1960 edition is more complete, more up-to-date, more essential than ever before because it provides expanded listings on new products and companies in the new areas of the total market. It will contain over 50,000 manufacturers' product listings divided into over 1,800 specific product categories. In addition to being quick and easy to use, the BUYERS' GUIDE includes complete listings of government procurement agencies telling: Where to go; Who to see; What they buy.

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71% still had their copy
9% passed on their copy to purchasing, engineering or other departments.

. . . of those who still had their copy:

16% referred to it once a week or oftener
44% referred to it once a month or oftener

Thus 60% referred to it at least once a month.

Advertisers' product listings are bold faced and include a reference to the page number of their advertising. In addition to an alphabetical advertisers' index, there is a "product" advertisers' index. To supply you with key industry sales leads the BUYERS' GUIDE contains Reader Service cards.

If you sell to the aviation industry, your advertising message belongs in the BUYERS' GUIDE . . . it will reach over 75,000 key engineering-management decision makers.

Be sure to reserve space in this exclusive issue . . . publishing date is mid-December and closing date is November 1, 1959.

BUYERS' GUIDE ISSUE FOR 1960

A McGRAW-HILL PUBLICATION
330 WEST 42ND STREET, NEW YORK 36, N. Y.

Aviation Week
Including Space Technology

If your career interests are in electronics and missile sciences

and you possess creative foresight

you will logically investigate Martin Orlando

Many engineers and scientists who make continuing appraisals of their futures are investigating new professional engineering positions with the Orlando, Florida, Division of The Martin Company. Our unusual growth record has opened many ground-floor opportunities for creative engineers who can manage and staff ambitious new programs.

Because Martin Orlando has prime responsibility for 5 major weapon systems, you are offered many channels for growth. Engineers find professional development is faster in the creative climate of Martin Orlando's new $20 million plant.

To help you make a realistic evaluation of what your part can be in the engineering success story at Martin Orlando, send for the free bulletin which gives you facts you need to reach a rewarding conclusion. Use the handy coupon.

MARTIN
ORLANDO

John F. Wallace, Dir. of Employment, The Martin Co., Orlando 7, Fla.
PLEASE SEND MY FREE COPY OF "280 SECONDS."
NAME_____
STREET_____
CITY_____ ZONE____ STATE_____

FINANCIAL

New Offerings

DIT-MCO, Inc., Kansas City, Mo.; principal business the manufacture and sale of circuit testing equipment and related consulting services. Offering is 33,333 shares of common stock; offering price and underwriting terms to be supplied by amendment. Proceeds will be added to general funds and will be available to reduce short-term bank borrowings, and other corporate purposes.

Servo Corporation of America, New Hyde Park, N. Y.; principal business the manufacture and design of equipments for use in infrared, electronics, data processing, servo devices and controls, etc. Offering is $1 million convertible debentures for public sale at 100% of their principal amount, and 67,000 shares of common stock to be offered pursuant to the company's Key Employe Restricted Stock Option Plan. Proceeds will be used for working capital, plant relocation and consolidation at Hicksville, N. Y., and expansion of equipment, increased development and research, and sales promotion and related activities.

Camloc Fastener Corp., Paramus, N. J. Offering is 150,500 shares of outstanding common stock; shares are to be acquired from a stockholder, and re-offered for public sale at $9 per share. None of the proceeds will be received by the issuing company. The company will purchase the remaining 100,000 shares held by the selling stockholder at $8 per share.

Financial Briefs

• **Southern California** industry will be awarded nearly $400 million in Army ordnance business during Fiscal 1960, it was forecast recently. New contracts to be awarded will be mainly in the Army missile field, involving new procurements and additional work under existing ordnance contracts. During Fiscal 1959, a total of $376 million in ordnance business was awarded southern California contractors.

• **Harnischfeger Corp.** postponed a 200,000 share common stock offering after the company board decided overall market conditions did not warrant proceeding now. Share prices of the Milwaukee manufacturer of welding equipment used by the aviation industry ranged from 27 to 34 this year and currently are around 29.

• **Texas Instruments** will earn $14 million—perhaps as high as $15 million

Corles Perkins, Chief of Flight Control Systems Honeywell Aeronautical Division

"I need analytical, systems, component engineers to work in flight control systems"

"Our team at Honeywell introduced the first successful electronic autopilot in 1941—the C-1 of World War II fame. Since, we have produced more flight control systems than any other company and have developed concepts in flight control that are now standard in this field. Today, most top aircraft and missiles are equipped with Honeywell flight controls. Our group has expanded steadily and now we need additional engineers.

"I'm looking for *analytical* engineers capable of simulating (mathematically on paper or computers) characteristics and problems in missiles and aircraft control, stability, and control systems. These men have good math backgrounds with analog computer experience.

"*Systems* engineers for our group should be capable of interpreting analytical results into navigation, guidance, or flight control systems. They should be electrical engineers experienced in systems—ideally, with experience in flight control in the aviation industry.

"*Components* engineers should be electronics men with emphasis on transistor circuitry. These are the men responsible for designing components which go into the system. Must have circuitry design experience.

"If you fit one of these categories, I'd like to hear from you. Just drop a line including pertinent information on your background, interests, and accomplishments to my Technical Director, Mr. Bruce D. Wood. He will arrange a meeting—to answer your questions about Minneapolis-Honeywell—to discuss your plans and the possibility of a career with Honeywell."

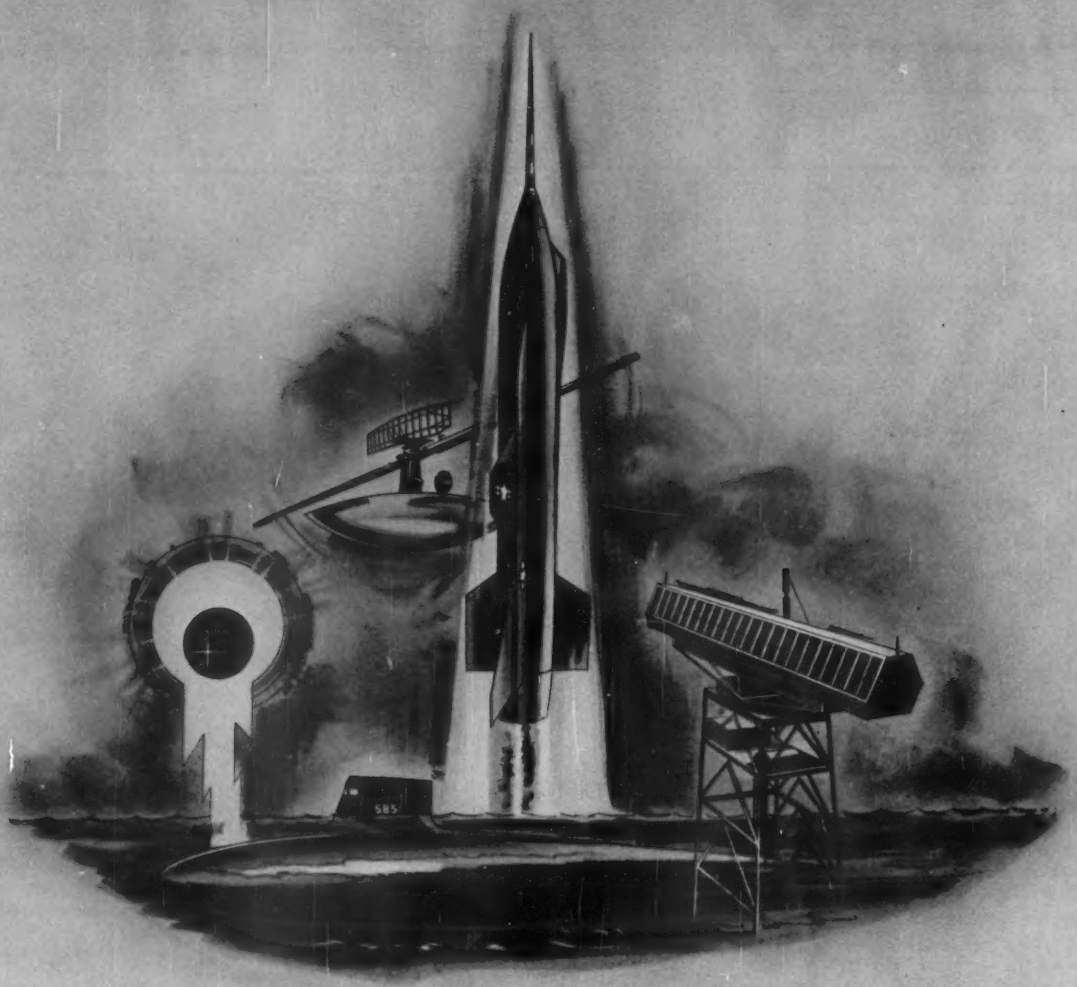
Write: Bruce D. Wood, Technical Director, Dept. 846N

MINNEAPOLIS **Honeywell** H HONEYWELL

AERONAUTICAL DIVISION

1433 Stinson Blvd., N.E., Minneapolis 13, Minn.

Fine opportunities also exist in other Honeywell development and manufacturing facilities in the Boston area, Philadelphia area, Los Angeles area, Minneapolis, Seattle, St. Petersburg, Chicago and Freeport, Illinois, Denver and the Washington, D.C. area. Send resumé to H. D. Eckstrom, Dept. 846N Director of Employment, Minneapolis Honeywell, Minneapolis 8, Minnesota.



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Your attention is invited to a limited number of senior positions created by Raytheon Government Equipment Division's current expansion.

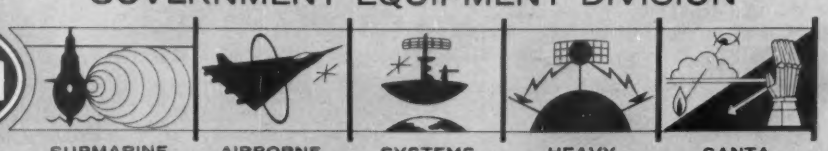
Comprehensive anti-submarine warfare systems
Advanced aerospace systems
Major electronic system programs
Long range surface radars, ordnance and communications systems
Infrared and countermeasures devices

For information on opportunities in each area, contact Mr. Donald Sweet, Executive and Engineering Placement, Government Equipment Division, Raytheon Company, 624 Worcester Road, Framingham, Massachusetts.

GOVERNMENT EQUIPMENT DIVISION

RAYTHEON

EXCELLENCE IN ELECTRONICS



SUBMARINE SIGNAL | AIRBORNE ELECTRONIC | SYSTEMS MANAGEMENT | HEAVY ELECTRONIC | SANTA BARBARA

—on sales of $195-200 million in 1959, company President P. E. Haggerty predicts. He forecasts rising spending for space vehicles and further reductions for manned aircraft. While he forecast increased missile spending, he also saw further weeding out and termination of less effective missile programs, the higher spending to go for increased efforts on more advanced systems.

• **Nicely diversified?** Essex Universal Corp., which describes itself as a leading manufacturer of missile support equipment and women's foundation garments, reports first quarter sales of $5,336,048 and earnings of $363,640. Its William Gluckin Division at Pittston, Pa., has added 52,000 sq. ft to its plant enabling it to produce 500,000 bras and girdles every week. Its Electro Cords Division in Los Angeles makes electric cables for missile launching use. Furthermore, Essex owns half interest in Art Theater of the Air, which packages films for television, featuring such stars as Gina Lollobrigida and Brigitte Bardot.

• **Voi-Shan Industries,** which began as a manufacturer of industrial screws and nuts under the trade name Pheoll, completed a transition to a manufacturer of diversified precision equipment. The company sold the name Pheoll and its Industrial Fasteners Division and Impact Extrusion Department for $4,100,000 during its 1959 fiscal year and adopted the name Voi-Shan, a maker of precision aircraft fasteners which it purchased in 1955. Proceeds from the sale will be used for further acquisitions. The company reported sales of $24 million in its fiscal year ended June 30, an increase of $1½ million. Earnings rose from $561,990 or $1.80 a share to $802,388 or $2.57 a share.

• **Moog Servocontrols, Inc.,** in its first public annual report after sale of 50,000 shares of common stock last April, reported net earnings of $513,355 or $1.03 a share in its fiscal year ended June 30, on sales of $10,366,744. The previous year it earned $114,969 or 26 cents a share on sales of $7,800,735. Backlog as of July 31 was $6 million.

• **Siegler Corp.** reported sales increased from $72,955,449 last year to $77,074,442 for the fiscal year ended June 30, with two-thirds of the total electronics and the remainder in heating and cooling equipment and specialized machinery. Earnings increased from $1,215,930 or 80 cents a share to $2,203,022 or $1.36 a share. Siegler reported a current ratio (assets to liabilities) of 2.32 to 1 and an increase in working capital to $19,587,543—typical of the favorable liquidity condition of many aviation industry companies this year.

Engineers

Technically demanding assignments coupled with high growth potential in a young and fast-growing Sperry division

First in flight control systems, Sperry has pioneered many significant "firsts" to make commercial aviation safer, more efficient . . . and military aviation more effective. Since 1912, when Lawrence Sperry flew the first airplane equipped with automatic controls, to the space-probing X-15, Sperry has provided flight control systems and instruments guiding both pilot and plane from take-off to touchdown. Unusual engineering opportunities are available to qualified engineers in many areas, including the following:

Microwave Guidance Development

Radar systems (ground, airborne, missile) • Radar Components (interrogators, transpondors, indicators and servos) • Digital data systems (coding, decoding, display)

Flight Control and Flight Instrument Systems

Transistor Circuit Development • Gyroscopics • Systems Development • Electronic Components • Electro-Mechanical Components

First in opportunity, the Sperry Phoenix Company is new and moving ahead fast! As a young Sperry Division, we offer you unlimited growth possibilities as man takes his first step into space. And, though young, we're backed by the experience and stability of the entire Sperry organization — almost a half century of continuous growth. You'll work in a modern air-conditioned plant, side by side with some of America's "name" engineers.

Take Advantage of this Opportunity for Fast Growth and Advancement . . . In a Company that has a Sound Balance of Commercial and Military Projects.

Please Address Inquiries to Mr. W. Roselius, Personnel Manager

SPERRY PHOENIX COMPANY
Division of SPERRY RAND CORPORATION
P.O. BOX 25295
PHOENIX, ARIZONA

SPECIAL KIND OF MEN

IN A SPECIAL KIND OF WORK

To help meet the urgent and continuing problems of national security, RCA has created an *Advanced Military Systems Department* at Princeton, New Jersey. There, in an atmosphere of complete intellectual freedom, men of a very special kind are engaged in the analysis and study of our national defenses—present and future—and how they can be made most effective to meet any future enemy capability.

THE MEN—The men who form the technical staff are a group of mature scientists and engineers. They are accustomed to responsible positions in industrial research, advanced development, or systems planning. Most of them have an extensive background in the broad fields of electronics, vehicle dynamics (space, marine or terrestrial), physics (astro, nuclear, or plasma), or operations research (military science). All are temperamentally suited for performing highly sophisticated, comprehensive analysis and planning. They are men who enjoy seeing the fruits of their work create a far-reaching effect on the defenses of the country.

THE WORK—Studies by this group are of the broadest scope and cover such diverse areas as physical and engineering sciences, military science, economics and geophysics. Accordingly, each member of the technical staff operates either independently or as a consultant in interdisciplinary groups. He is generally free to select his own area of work, but results must have a direct application to problems of national defense.

As a staff member, he is provided with every opportunity, facility and detail of environment to use creative and analytical skills to maximum advantage and at the highest level. He has no responsibility for administrative details. He can call in any specialists he may need. He has full access to all available information—military, academic and industrial. Furthermore, specialized research projects and laboratory work can be carried out at his request by other departments of RCA.

THE LOCATION—Princeton offers unique civic, cultural and educational advantages. The RCA Advanced Military Systems Department itself occupies a new, air-conditioned building on the quiet, spacious grounds of RCA's David Sarnoff Research Center. Working in individual, well-furnished offices, staff members find their associates and surroundings highly conducive to creative activity, and the community ideal for gracious living in a university atmosphere.

INQUIRIES ARE INVITED—If you are interested in learning more about this far-reaching program and the unusual opportunities it offers to qualified men, write:

Dr. N. I. Korman, Director,
Advanced Military Systems, Dept. AM-2JA
RADIO CORPORATION OF AMERICA,
Princeton, New Jersey.

EQUAL JOB OPPORTUNITY

RCA **RADIO CORPORATION of AMERICA**

WHO'S WHERE

(*Continued from page 23*)

Changes

Lee C. Keene, director-instrument and electronics engineering, and **O. T. Fleig**, director-maintenance scheduling and planning, American Airlines' Jet Maintenance and Engineering Center, Tulsa, Okla.

Robert Sherwood Kinsey, director of engineering, Electro Tec Corp., South Hackensack, N. J. Also: **Charles N. Liskey**, plant manager, Electro Tec Corp.'s Blacksburg, Va., Division.

Ernest Schubert, technical director, Monitor Systems, Inc., Fort Washington, Pa., subsidiary of Epsco, Inc.

Frank Manov, supervisor of the newly formed satellite and space defense studies group, Electro-Optical Systems, Inc., Pasadena, Calif. Also: **A. T. Forrester**, head of the Ion Propulsion Laboratory, Fluid Physics Division; **David T. Traitel**, manager of information services.

Rear Adm. T. M. Bennett (USN, ret.), executive assistant to the associate manager of research development, Aerojet-General Corp.'s Solid Rocket Plant, Sacramento.

Richard H. Boutelle, chief health physicist, Nuclear Division, The Martin Co., Baltimore, Md.

Warren R. Smith, assistant to the president on special assignments and director of corporate public relations and advertising programs, Fairchild Engine and Airplane Corp., Hagerstown, Md.

Richard T. Barrett, manager of advanced systems sales, Lockheed Electronics and Avionics Division, Los Angeles, Calif. Also: **Alex Petrovsky**, manager of the LEAD design engineering division.

Capt. Norman Lee Barr (USN, ret.), chief of Space Environment and Life Sciences research, Republic Aviation Corp., Farmingdale, N. Y.

Ted J. Carrell, engineering manager, Parker Seal Co., Culver City, Calif.

T. F. Dixon, director of engineering, Rocketdyne, a division of North American Aviation, Inc., Canoga Park, Calif. Also: **P. R. Vogt**, chief engineer, liquid propellant engines; **J. F. Torney**, chief engineer, solid propulsion.

Alan R. Gruber, director of the newly established Nuclear Systems, Marquardt Corp., Van Nuys, Calif. Other appointments in the new Division: **A. O. Mooneyham**, manager, Nuclear Projects Department; **Karl Bernstein**, manager, Nuclear Design Department; **Laurance U. Hurley**, manager, Experimental Engineering Department; **John W. Cresse**, manager, Administrative Operations.

Richard T. Branch, director of quality and reliability assurance, Crosley Division, Avco Corp., Cincinnati, Ohio.

Jack Keir, director of military engineering, Military Equipment Division, Fruehauf Trailer Co., Detroit, Mich.

O. R. Anderson, chief engineer, American Science and Engineering, Inc., Cambridge, Mass.

Glenn R. Lord, manager, and **Fritz A. Gross**, assistant manager, Government Equipment Division, Raytheon Co., Waltham, Mass.

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | **Civil Service Opportunities** | **Employment Agencies**
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Aerodynamicists

Preferably with advanced degrees and at least 6 years experience in:

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- **Stability, Vehicle Dynamics and Trajectory Mechanics**
- **Preliminary Design**
- **Theoretical, Experimental or Applied Research**

. . . to work in these specialties on problems related to flight of lifting and non-lifting vehicles at extremely high speeds and altitudes.

Attractive working environment close to metropolitan Boston.

Write to: Mr. Richard Rubino
Scientific and Technical Relations
Dept. FD1

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Research & Advanced Development

201 Lowell St., Wilmington, Mass.

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. . . Positions at several levels including supervisory
. . . High salaries — commensurate with ability and experience

Interesting and challenging positions with Republic Aviation Corporation for electronic engineers to develop test equipment, methods and procedures for determining the conformance of complex electronic equipment to AF and Company quality control specifications and standards.

Work closely with other engineering groups and electronic manufacturers to determine types of equipment required to test and simulate flight operations of radar, navigation, fire control, and other types of electronic systems.

Develop procedures and methods for use of electronic test equipment. Assist supervision with manufacturing problems. Investigate malfunctioning of electronic equipment off and on aircraft. Prescribe corrective action. Make recommendations in methods and procedures as may be required to meet new developments in the electronic fields.

Send resume in confidence to: Mr. William Walsh

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Farmingdale, Long Island, N. Y.
Less than 1 hour from New York City

Wanted: Director of Aviation Safety Division of University of Southern California.

To administer internationally known teaching program in air safety conducted for military and civilian groups. Qualifications include military pilot experience; academic degree in engineering, management or related field; five years experience in management and development programs involving technical personnel; experience in air safety desirable but not required. Salary $11,000 and up depending on qualifications. Annual vacation of one month.

Write Dean,
University College,
University of Southern California,
Los Angeles 7, California.

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If You're important, you either read
AVIATION WEEK
or you advertise in it, or both

WORKS MANAGER AIRCRAFT COMPONENTS OVERHAUL

Expanding Long Island firm require services of top-notch experienced Man to manage our AIRCRAFT COMPONENT Overhaul Operations.

- Should be thoroughly familiar with ENGINE, TRANSMISSION and related HIGH-SPEED ROTARY COMPONENT OVERHAUL.
- It should be emphasized that this position carries heavy responsibilities with the Salary commensurate with background and experience. Activities will include complete production and administrative coordination of programs.
- Several programs, both Military and Commercial, currently operating.
- This position represents a ground floor opportunity for the right person. Many benefits. Send resume to: Box AW-1393, 125 W. 41 St. N. Y.

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High Level Openings at AVCO for

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- **EXPERIMENTAL PHYSICISTS**
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New and expanding programs concerned with the design, development, and flight evaluation of the Titan and Minuteman re-entry vehicles have opened up exceptional opportunities in the following areas:

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Challenging opportunity to apply unusual high temperature techniques developed in the Division to these areas.

The division's fully equipped laboratory and new suburban location provide an unusually attractive working, and recreational environment. Excellent opportunities exist for independent research .

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Scientific & Technical Relations
Dept. AW-10

Your reply will be accorded absolute confidence and you will receive a prompt answer.

AVCO
Research & Advanced Development
201 Lowell St., Wilmington, Mass.

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A NEW STATE OF THE ART

We have succeeded in the development of an entirely new concept for the SUCCESSFULL placement of qualified engineers and scientists we now have in excess of 4,000 openings in the $8000.00 to $60,000 bracket. Never a charge to applicant for confidential consideration. Submit resume in duplicate indicating geographical preference and salary requirements.

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at General Electric's Communication Products Dept. in Lynchburg, Virginia

Serving both industrial and military customers, the Communication Products Department offers engineers a unique type of professional stimulation—through participation in *integrated* design and production programs in advanced communication systems.

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Immediate openings for men with Project Engineering or Group Leading experience in these areas:

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Write for data sheets on the Department and literature describing the attractive residential city of Lynchburg. Address Mr. Arthur Guy, Section 64-WP.

COMMUNICATION PRODUCTS DEPT.
GENERAL ELECTRIC
Mountain View Road
Lynchburg, Virginia

"AT SOME POINT IN HIS CAREER, every engineer critically evaluates himself in terms of his professional growth and progress. If your evaluation indicates that you have developed a depth of appreciation for the major problem areas in large complex electronic systems and the technical competence to contribute to the solution of such problems, you should seriously consider the next step in your professional career and explore the challenging opportunities the System Development Corporation has to offer.

"SDC has assumed major responsibilities for development and sustaining engineering and the implementation of engineering advances in the state of the art associated with the SAGE Air Defense System, the world-wide SAC Control System, and other major system development projects. Therefore, at SDC engineering is system-oriented and requires personnel with broad backgrounds and extensive experience in design, development and system engineering.

"The experience gained through intimate association with all of the elements of these large-scale systems and subsystems they control provides a most unusual opportunity for engineers to grow in technical competence and professional stature.

"I invite you to explore the opportunities offered by SDC at Santa Monica, California and Lodi, New Jersey, by writing or telephoning Mr. R. A. Frank, 2404 Colorado Avenue, Santa Monica, California, EXbrook 3-9411, or Mr. R. L. Obrey, Box 2651, Grand Central Station, New York 17, N.Y., ELdorado 5-2686, regarding our division at Lodi, New Jersey. Your correspondence will receive preferential treatment and its content will be handled in strict confidence."

V. J. Braun

V. J. BRAUN, ASSISTANT DIRECTOR FOR PLANNING, ENGINEERING DIRECTORATE

V. J. BRAUN

11-126

SDC

SYSTEM DEVELOPMENT CORPORATION

SANTA MONICA, CALIFORNIA • LODI, NEW JERSEY

ADVANCED MILITARY SYSTEMS TECHNICAL PLANNING

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He will be expected to:

Interpret future military requirements
Analyze advanced system applications
Determine new system technical requirements and preferred configurations
Recommend development approaches and programs.

Pertinent background for this man could include:

Development or operations analysis of weapons systems or their electronic subsystems
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Advanced degree in Physics, E E or Aero E.

To explore this staff opportunity, write: J. F. Healey, Director of the Advanced Systems Planning Staff, Dept. 885-G, 2600 Ridgway Road, Minneapolis 13, Minn.

MINNEAPOLIS
Honeywell

Military Products Group
Aeronautical, Ordnance, Missile Equipment and Boston Divisions

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This appointment involves responsibility for determining design policy, making major design decisions and the organizing and direction of groups engaged in the design of commercial and military aircraft radio, radar and electronics systems and specialized installations on A.S.W. and fighter aircraft. Reports to Chief Design Engineer.

Applications are invited from graduate engineers with supervisory experience in two or more of the above fields. Experience in the design of equipment an asset and other related experience will be evaluated in the light of applicability.

Convenient interviews will be arranged for suitable applicants. Please submit details of qualifications and experience, including salary history, to:

William K. Ebel
Vice-President, Engineering
Dept. E

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the Canadian Subsidiary of
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$13,000 to $16,000

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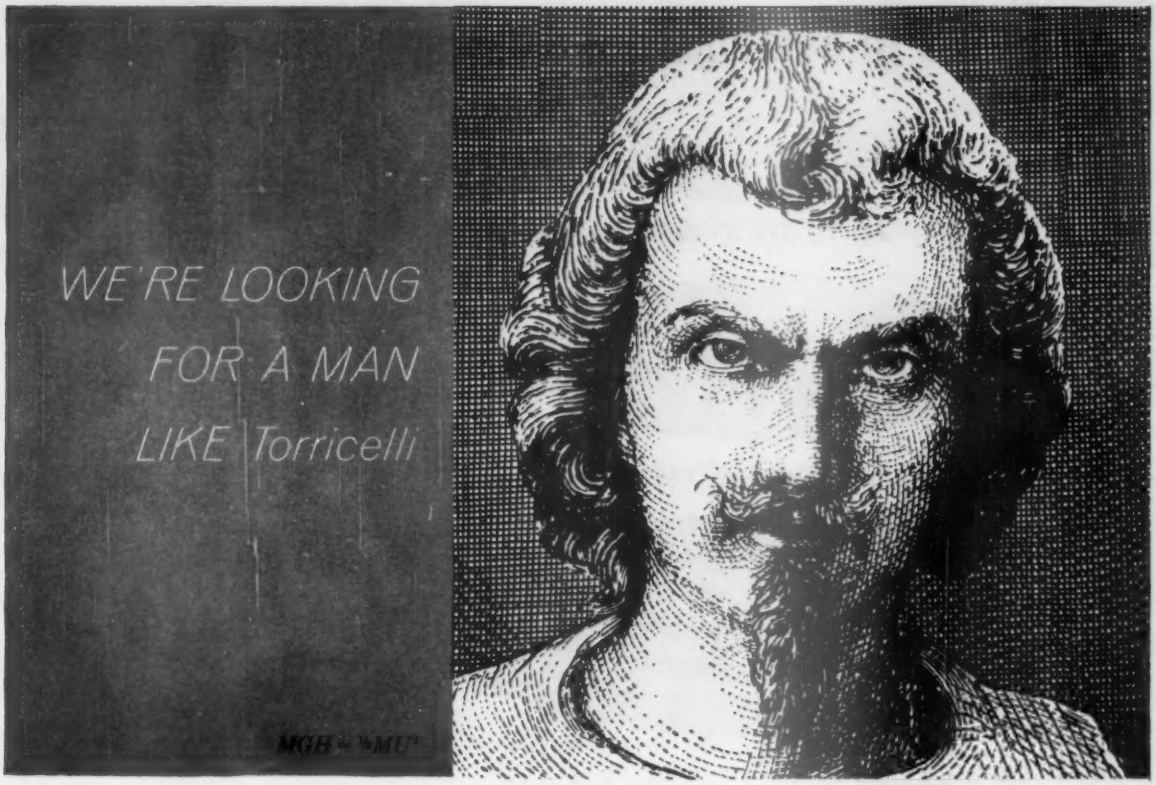
■ The position requires strong ability in system analysis and synthesis with experience in military systems and/or equipment desirable. Familiarity with military electronic equipment such as displays, data processing and communications equipment and some knowledge of modern weapons and their employment is also needed.

■ Those interested in considering this position should have a Master's degree (Ph.D desirable) and at least five years' experience in above or related fields. Training and experience should be recent with interest shown in keeping abreast of new developments in operations research, linear programming, game theory and/or theory of communications, information and noise.

■ Inquiries will be considered in confidence. You are invited to send your resume to

P-2364, Aviation Week
1125 W. 6th St., Los Angeles 17, Calif.



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This knowledge, centuries old, lies at the base of searching problems facing the exploration of space.

At Goodyear Aircraft, hand-picked men with a modern turn of Torricellian mind are finding rewarding stimulation of their talents in programs involving Crew-Escape Capsules—in the perfection of mass-production nose cones of optimum efficiency.*

New multimillion-dollar research and development facilities—in Akron and in Litchfield Park, Arizona—are manned by this good company of men who would welcome good company like you.

If you have a Torricellian talent and are seeking a challenge that has solid substance and long-range surety—then write direct: Mr. Charles Jones, Director of Technical & Scientific Personnel, Goodyear Aircraft Corporation, Akron 15, Ohio.

*Also programs in rocket propulsion, interplanetary guidance, ground support systems for missiles, nose cones, radar structures, advanced black boxes, radomes and structures engineering.

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There are systems

...and systems

...and TOTAL systems in which the big bird and support equipment may rank only as a component.

This difference between systems can make a big difference in your career

IF YOU ARE QUALIFIED and interested in contributing to programs of "total" scope, it will be of value to you to investigate current opportunities with General Electric's DEFENSE SYSTEMS DEPT., whose work lies primarily in providing *total* solutions to large scale defense problems of the next 5, 10 and 20 years.

The work here lies almost entirely in the areas of systems engineering and systems management.

Inquire about these positions:

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- Systems Logistics Engineers
- Electronic Systems Management Engineers
- Operations Analysis Engineers
- Systems Program Engineers
- Data Processing Engineers
- Systems Test Evaluation Engineers
- Engineering Psychologists
- Radar Equipment Engineers
- Weapons Analysis Engineers
- Weapons Systems Integration Engineers
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Whereas the growth potential is evident – both for DSD and the engineers who join us – the positions we fill during these early months will carry significant "ground-floor" benefits.

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DSD DEFENSE SYSTEMS DEPARTMENT
A Department of the Defense Electronics Division

GENERAL ELECTRIC

300 South Geddes Street, Syracuse, N. Y.

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If you are an electrical or mechanical engineer searching for an environment in which to more fully exercise your ingenuity and creative ability, then plot your trajectory to the AVIONIC DIVISION.

Oster®

Located on Lake Michigan between Chicago and Milwaukee, the AVIONIC DIVISION offers you the opportunity to join its steadily expanding engineering department. Positions are available at all levels in these functions:

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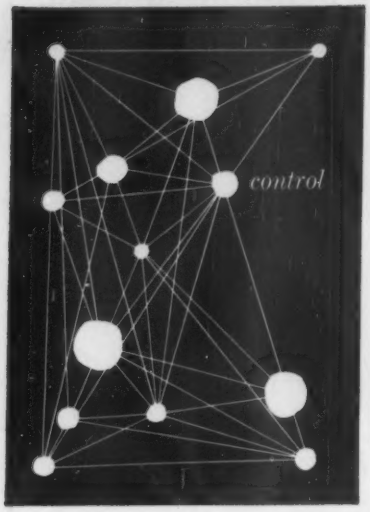

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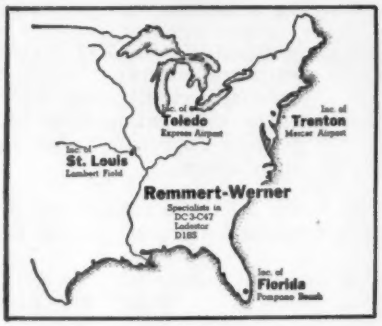

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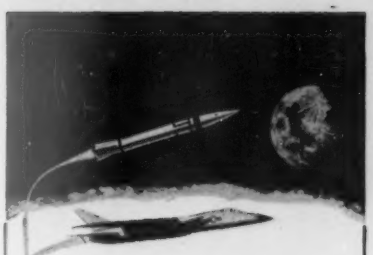

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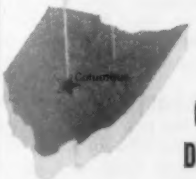

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LETTERS

Highest Caliber

We were certainly pleased to read Erwin J. Bulban's article, "Civil Company Trains 1,000 Helicopter Pilots Annually," in your Sept. 7 issue (p. 104). He has again come up with another extremely well-written piece which provides such an exact, detailed description of helicopter training and maintenance being conducted under contract for the Army by Southern Airways Co. at Camp Wolters, Tex.

We have seen Pete Bulban working on his articles and have always marveled at the extent to which he explores his subject matter and comes up with pertinent information which could so easily be overlooked. We have been fortunate to have him with us on a number of press tours and his editorial productivity (for example, "USAF's Contract Training Saves Money," in the Dec. 17, 1956, issue) has always been of the highest caliber. We just felt the urge to express these feelings.

HARRY S. BAER, JR.
Secretary-Treasurer
Aeronautical Training Society
Washington, D. C.

Pilot's Question . . .

Perhaps someone would care to enumerate the possible benefits to be expected from abandoning simplex communication on 126.7 megacycles in favor of "dual channel simplex" operation in which air-to-ground communication will be carried on 126.7 mc., with the ground station relying on 120.7 mc.

To promote debate on this subject, I will list four good reasons for not adopting the new system.

1. Dual channel operation deprives the pilot of valuable information obtained from hearing the position reports of other aircraft. Hearing other pilots not only lent a pleasant Kaffee-Klatsch atmosphere to the cockpit, but provided a valuable, informal check on the activities of any center personnel who might have fallen victim to dyspepsia.

2. "Blocked" transmissions may be expected to increase in frequency because the pilot will not know, at the moment he initiates his position report, whether another aircraft is talking to the controller.

3. Airborne equipment becomes more complex. Transceivers must be capable of operation in the dual channel mode, or separately tuned transmitters and receivers must be used.

4. Information handling capacity is reduced. Presumably the new policy is being implemented with the idea in mind that two channels will carry twice as much information as one. This is true, however, only when the two channels are used continuously. In the case of air-to-ground communications, this potentiality cannot be realized because of the limiting nature of the human terminal equipment. The controller cannot send and receive simultaneously or, at least in the interest of safety, ought not be expected to do so. Dual channel operation, therefore, uses two channels to handle the information formerly carried on one. The obvious way to increase information handling capacity would be to initiate simplex operation on both 126.7 and 120.7, and install dual controllers.

An informal poll of pilots by the writer has revealed reactions to the new policy ranging from outrage through high dudgeon to mild dismay; individual reaction being conditioned, no doubt, by the amount of radio gear which the pilot has available for coping with the added demands of dual channel operation. Not one favorable comment has been heard.

I venture the prediction that if the new system relieves the congestion on 126.7 mc., it will be only because everyone has shifted to 135.9 mc., where simplex operation is still the rule.

If any reader has a good word to say for the new policy, I'll be listening (simplex) on 135.9.

PHILIP L. EPSTEIN
The Hartman Electrical Mfg. Co.
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Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

. . . FAA's Answer

The change from the single channel simplex communications was considered as a result of the extensive study of Special Working Group 13 of the Air Coordinating Committee. Among the conclusions of this group were:

(1) The trend to higher operating altitudes increases the communications interference potential due to the large amount of ground and airborne stations that come within line of sight.

(2) Approximately 95% of the future air/ground communication needs of the air traffic control service will require protection from objectionable interference at altitudes above 5,000 ft.

A formal en route communications channel survey was conducted in all Federal Aviation Agency air traffic communications stations during October and November, 1958, and February and May, 1959, in order to obtain channel utilization information by general aviation, military and air carrier pilots. The following survey figures indicate the radio contacts on channels used by general aviation pilots during air/ground communications with the FAA stations:

(1) 126.7 mc. single channel simplex 82,896 contacts
(2) 126.7 mc. double channel simplex 50,495 contacts
(3) 122.1 mc. double channel simplex 215,065 contacts

Total contacts with aircraft using the double channel simplex mode (2+3) were 265,560, indicating that a large majority (76%) of pilots in general aviation are using this method in lieu of single channel simplex.

The Flight Information Manual outlines the frequency utilization plan for 108-132 mc. and states that 132.00 mc. and higher are for government use. The present simplex channel of 135.9 mc. is normally used by Navy aircraft. Air Force aircraft use 135.9/135.0 mc. double channel simplex operation.

Where a common frequency is so widely used, we believe that better service can be provided through double channel simplex operation. However, since our survey shows that a hardship would be imposed on some of the users if 126.7 mc. single channel simplex operation were eliminated, this service will remain available in addition to double channel simplex operation.

HENRY S. CHANDLER, *Chief*
Field Operations Division
Bureau of Air Traffic Management
Federal Aviation Agency
Washington, D. C.

Security System

After having been "scooped" a number of times because of industry and government clearance procedures, I must disagree with Alan Pope, "News Freedom," (AW Sept. 7, p. 166.)

Certainly, from a scientific or engineering standpoint Mr. Pope makes sense, but I doubt if his opinions would stick if he had experience in the news writing field.

For instance, I have withheld a story for several months waiting for clearance from the powers which give it—just as Mr. Pope would have me do. However, in the same issue of AVIATION WEEK, in which Mr. Pope writes, I find mention of the "secret" I have so carefully guarded. Undoubtedly, AVIATION WEEK was able to get clearance—but I am still waiting. Why?

At another time I was subjected to hours of litigation after applying for permission to take a few photos of an Air Force installation. I did get permission, however, but the whole procedure seemed rather foolish when, on a recent trip to Italy, I saw tourists including the same installation in pictures they were taking from the airplane.

And how does Mr. Pope explain the recent Nike Zeus story which was carried over the wire services? Why did the Air Force say the missile's range was top secret when the reporter was able to quote it exactly from data in an industrial publication?

If a reporter is able to obtain photos of Titan with a telephoto lens, so are the Russians. And if a reporter is able to fly over the Douglas plant for a missile picture, this doesn't seem like such a tough job for Red agents either.

Rather than criticizing the press, it seems as if some thanks are due. At least we're able to underline the country's security weaknesses—and perhaps Mr. Pope's shortcomings—by carrying out our assignments as we know how.

The solution is not to lock up ambitious reporters, but to reevaluate the entire security system.

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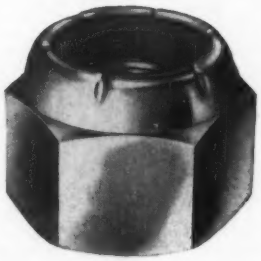

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